THE

TEA CYCLOPÆDIA,

A VOLUME OF SELECTIONS

FROM LEADING AND ORIGINAL ARTICLES,

CORRESPONDENCE, AND PAPERS,

REGARDING

Matters of PERMANENT Interest and Value concerning

TEA AND TEA SCIENCE, TEA BLIGHTS, SOILS AND MANURES, TEA CULTIVATION, BUILDINGS AND MANUFACTURE, MISCELLANEOUS TEA TOPICS, TEA STATISTICS,

&c., &c., &c.

Collated from the last eight Volumes of

THE INDIAN TEA GAZETTE,

AND FROM

SEVERAL OTHER VALUABLE SOURCES,

AND

CLASSIFIED ACCORDING TO SUBJECTS;

By the Editor of the "Indian Tea Gazette."

F. Wyman.

ILLUSTRATED WITH COLORED PLATES ON "BLIGHTS,"

FROM DRAWINGS BY S. E. PEAL.

1881.

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PREFACE.

When first this Work was projected, it was intended to confine it to a compilation of matters of permanent interest and value from the "Indian Tea Gazette" alone. In the progress of the compilation, however, it occurred to the Editor that extracts from other suitable sources, bearing on the question of Tea, would add to the value of this Volume. Therefore, opportunity has been taken to supplement the very large amount of information compiled from the *Tea Gazette*, by the addition of certain specialist articles from the latest published Encyclopædia, and by appropriate selections from contemporaneous literature. Also, advantage has (by permission) been taken of a small pamphlet issued recently, containing a summary of opinions on CULTIVATION and MANUFACTURE, from leading Planters.

Of course, unanimity of opinion upon the different important Tea topics discussed in this Work is not to be expected, but the reader will be able to judge for himself, in each particular case, on which side lies the balance of argument and proof.

The knowledge of Tea Cultivation and Manufacture has so much advanced of late years, and the introduction of machinery has brought about so many important changes, that a compilation of the kind now presented has become almost a necessity for the Book-shelf of every one interested in any way in Tea in India; and the publication for the past few years of the *Indian Tea Gazette*—a purely specialist Journal,—has enabled the Editor to lay before his readers a very exhaustive epitome of the opinions and observations of the many who have made TEA CULTIVATION in India a subject of special thought and study.

The Editor has, himself, spared no pains to render this Work in every way as complete as possible, and he trusts that this will be the opinion of those who honour him with their support and approbation.

CALCUTTA,
March 1881.

SYNOPSIS.

THIS Volume has, for greater convenience to readers, been divided into PARTS, with separating half-titles.

The first section treats of Tea Science, and the botany and chemical properties of TEA, as well as of the early history of the Industry.

The second section is devoted to a reproduction of the most valuable papers on, and correspondence and opinions regarding, "Tea Blights and Tea Pests," which have appeared in the pages of the *Tea Gazette* during the last four years, as well as in those of contemporaneous journals.

The third part is devoted to an exhaustive consideration of every point bearing upon TEA CULTIVATION and MANUFACTURE for the past four years, arranged as nearly as possible under distinctive sub-heads.

Part IV contains special reference to the principal Tea Districts of India, with incidental notes on the less important districts, while statistical tables of INDIAN TEA CULTIVATION, as far as published to date, are appended.

Part V shows the countries, other than China and India, in which Tea Cultivation is now being carried on, or has at any time been attempted.

Part VI refers to the discussions which have taken place regarding the opening up of new markets for Indian Tea, and of operations as far as they have gone at present, or have been projected.

Part VII is devoted to miscellaneous subjects of interest connected with Tea and the Tea Industry.

Part VIII, the concluding part, contains Tea Reviews for the past year, and valuable Tea Statistics for the past ten years.

The selection of matter, for all the foregoing, from the pages of the *Tea Gazette* and several other sources, which will be found herein focussed and grouped under respective main and sub-headings, has been carried *up to present date;* so that the latest opinions and information regarding "Tea in India" will be found in this Volume.

The INDEX at end of the Volume will be found to afford ready reference *to the smallest item of detail,* as *each subject* referred to *in every paragraph* has been selected and indexed.

The present Volume is not a mere literal transcript from the columns of the *Tea Gazette* and other sources. True, many valuable papers have had to be given entire; but where it could be done without injury, only the most salient points of information and argument have been inserted, notably in respect to the "Correspondence" on the many and varied subjects which will be found discussed in these pages. Unnecessary bulk has thus been avoided.

The different sizes of type used are intended to indicate the character of the matter inserted; the larger type being, as a rule, devoted to "leading articles and important or original papers," and the smaller type to "extracts from correspondence" and "selections."

Subjects, only, of *permanent* interest have been treated of in this Work.

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TEA CYCLOPÆDIA.

THEA.

THEA, a genus of Plants belonging to the tribe *Camellieæ* and natural order *Ternströmiaceæ,* which has been so named from the slightly altered Chinese name of the dried herb which now forms the almost universal beverage of the British Isles. Though now so extensively employed, the introduction of tea into Europe is of comparatively recent origin.

Tea, however, must have been used in China from very early times. It is differently named in different parts of China, as Tcha, or Cha, also Tha, whence we have Tsia, The, and Tea. In Persian works in use in India, tea is called Cha-Khutai, or Tea of Cathay.

The genus *Thea* is characterised by having a calyx which is persistent, without bracts, 5-leaved, leaflets imbricated, the outer ones smaller; petals of the corolla 6 to 9, hypogynous, imbricated, the inner ones the largest, all adhering together at the base; stamens numerous, in several rows, adhering to the bottom of the petals; filaments filiform, anthers incumbent, 2-celled, oblong, with a thickish connectivum, cells opening longitudinally; ovary free, 3-celled; ovules 4 in each cell, inserted alternately into the central angle, the upper ones ascending, the lower pendulous; style trifid, stigmas 3, acute; capsule spheroidal, 2-3-lobed, 3-or by abortion 2-celled, with loculicidal dehiscence, or with the dissepiments formed from the turned-in edges of the valves; seeds solitary or rarely two, in cells, shell-like testa, marked with the ventral umbilicus; cotyledons thick, fleshy, oily; no albumen; radicle very short, very near the umbilicus, centripetal.

The genus *Camellia* is usually considered to be very distinct from *Thea;* indeed by Cambessedes the two are separated from each other by several intervening genera: they are, however, too closely allied to allow of this separation. Distinctions have been made in the fruit of the two genera. That of *Thea* is 3-lobed with obtuse corners and opening along the middle of the lobes, that is, having the dissepiments opposite to the valves, or, as expressed by modern botanists, having a loculicidal dehiscence. *Camellia,* on the contrary, is described as having its fruit obscurely triangular, without any tendency to become deeply 3-lobed, with the margins of the valves turned inwards and forming the dissepiments, which thus alternate with the valves, and have what is now called a septicidal dehiscence. Mr. Griffith, on the contrary, who is well qualified to form a correct opinion, states, from examination of the Assamese tea-plant and of two species of *Camellia* from the Khasia Hills, that there is no difference between *Thea* and *Camellia.* The dehiscence in both, he says, is of the same nature, that is, loculicidal, and the only difference that does really exist is simply of specific value, consisting in the fruits of the tea-plant being 3-lobed, of the *Camellia* triangular.

The species of the genus *Thea* are

few in number; some botanists are of opinion that even these are varieties of a single species.

T. viridis is a large, strong-growing, almost hardy plant, with spreading branches; its leaves three to five inches long, thin, almost membranous, very broadly lanceolate, light green and wavy, with large and irregular serratures, the flowers large, usually solitary, mostly confined to the upper axil, with 5 sepals and from 5 to 7 petals; fruit nodding. This species is figured by Dr. Lettsom in his account of the tea-plant, t. 1, and by Sir, W. J. Hooker, 'Bot. Mag.,' t. 3148, and in Loddiges' 'Bot. Cab,' t. 227, all from plants which have flowered in this country. Kæmpfer supplies a very good figure, 'Amœn. Exot,' p. 607, from a Japanese plant. This species is found both in China and Japan, and is supposed to be the species which yields the green tea of commerce. It has been long introduced into this country, having been first sent from Japan in 1687 to the Cape of Good Hope, and thence into Europe.

T. Bohea is a smaller plant than *T. viridis:* its branches are stiff and straight, its stem erect, the leaves not above half or two-thirds of the size of the former species, elliptical oblong, perfectly flat, more coriaceous, of a dark green colour, with small and even serratures; they are numerous, and have in their axils two or three flowers, of 5 sepals and 5 petals; these are smaller and have a slight fragrance, and flower later in the season than *T. viridis.* The plant is much more tender than the green tea-plant, unable to stand the cold of an English climate. It is supposed by some to yield the leaves which are converted into black tea, and, notwithstanding contrary statements, leaves similar to those of this plant may be recognised on infusing and spreading out the leaves of some of the black teas of commerce. [TERNSTRÖMIACEÆ.] A variety of this is sometimes called *T. stricta.* It is figured by Lettsom, ed. 2, p. 41, who considers it only a variety of the former. It is also figured by Loddiges, 'Bot. Cab.,' t. 226, who, as well as Sir W. J. Hooker and Dr. Royle, considers it to be a distinct species.

T. Assamensis, the Assam tea-plant, which some years ago attracted so much attention, seems to partake of the characters of both the foregoing. The Calcutta Tea Committee say, in 1835: "We are now enabled to state with certainty that not only is it a genuine tea, but that no doubt can be entertained of its being the identical tea of China, which is the exclusive source of all the varieties and shades of the tea of commerce." To this it may be replied, that there are considerable doubts whether the teas of commerce are all derived from one species of plant. Mr. Griffith says, in the size both of the plant and of the leaves, as well as in the texture of these last, and in its stations, the Assamese plant approaches to the green tea-plant of China; in its geographical distribution, so far as latitude is concerned, it approaches to the black tea. The inflorescence of the Assamese plant varies, but perhaps its usual state is to have the flowers solitary in the axils of the leaves, but the number of flowers varies from one to five. The plants introduced into this country have their leaves much larger and thicker than those of the green tea-plant, and Messrs. Loddiges find that it requires a much greater degree of heat, in fact that of the hot-house, while the others are in the open air for a great part of the year.

Two other species, described by Loureiro, are little known, as *T. Cochin-chinensis,* about eight feet

high, having lanceolate leaves, flowers of three to five sepals and five petals, solitary, terminal; found wild in the north of Cochin-China, where it is also cultivated, being used medicinally by the natives as a diaphoretic. *T. oleosa* is also a shrub of eight feet high, found in the fields in the neighbourhood of Canton, and named from its seeds yielding a large quantity of oil, which is used for burning and as an article of diet. The leaves are lanceolate, the flowers of six sepals and six petals, peduncles 3-flowered, axillary; fruit stated to be indehiscent rather a berry than a capsule.—*English Cyclopædia.*

TERNSTRÖMIACEÆ.

Theads, a natural order of Polypetalous Exogenous Plants. It consists of trees or shrubs with alternate coriaceous leaves, without stipules, mostly undivided, and sometimes with pellucid dots. The flowers are generally white in colour, sometimes pink or red, and are arranged in axillary or terminal peduncles, articulated at the base. The calyx is composed of 5 or 7 sepals, imbricated in æstivation, the innermost the largest; petals 5, 6, or 9, often combined at the base; stamens indefinite, with monadelphous or polyadelphous filaments, and versatile or adnate anthers; ovary superior; capsule 2-7-celled; seeds few, attached to a central axis, with little or no albumen, and a straight embryo, the cotyledons of which are very large, and often filled with oil. This order includes the *Theaceæ* of Mirbel and the *Camellieæ* of De Candolle. Their closest affinity is with the order *Guttiferæ*, from which they differ in their alternate leaves; in the parts of their flowers being 5 and its multiples; in the calyx being distinct from the corolla; in their twisted æstivation, and in their thin inadherent cotyledons. They have also relations with *Hypericaceæ* and *Marcgraaviaceæ*. The plants of this order are principally inhabitants of Asia and America; one species only is a native of Africa. —*English Cyclopædia.*

CAFFEINE.

Thèine Guaranine (C_{16} H_{10} N_4 O_4 + 2 Aq.). A crystalline alkaloid found in coffee, tea, and two other vegetable preparations, namely, in guarana, a paste prepared from the seeds and other parts of the *Paullinia sorbilis*, and in the leaves of *Ilex Paraguayensis*, both of which are used in the production of beverages in the Brazils and a few other parts of the world. Caffeine was first discovered in coffee by Runge in 1820, and a few years afterwards in tea by Oudry, who called it thèine: the identity of the two substances has since, however, been fully established.

It exists, according to Payen and other chemists, in combination with potash and chlorogenic, caffeic or caffetannic acid, and is best prepared as follows:—A decoction of tea or coffee is mixed with excess of solution of basic acetate of lead and filtered; through the clear liquid is passed a current of sulphuretted hydrogen, the sulphide of lead separated by filtration, and the filtrate evaporated to a small bulk. On cooling the caffeine crystallises out nearly pure, and may be rendered quite white by boiling in water or ether with a little powdered animal charcoal, filtering and recrystallising.

So obtained, it presents the appearance of long silky needles. They contain 8·4 per cent. of water, which is not thoroughly separated below a

temperature of 302°. At 352° they melt, and at a higher heat sublime without decomposition. It is readily soluble in ether; also in boiling alcohol or boiling water, but from these it nearly all crystallises out on cooling. Heated with strong alkalies it is decomposed with production of methylamine. Hydrochloric acid dissolves it, but on evaporation it is deposited unchanged. Caffeine, nevertheless, does possess basic properties, and, by carefully avoiding the presence of water, several well-defined salts may be obtained. The most remarkable and beautiful of these are the double chlorides with platinum, gold and mercury.

Caffeine is powerfully attacked by oxidising agents, giving rise to several bodies of considerable interest, inasmuch as they establish its intimate connection with the uric group of the formic series of organic compounds. These are: 1st, amalic acid, obtained by Rochleder on passing a current of chlorine through caffeine suspended in water, stopping the gas before the caffeine is all dissolved, filtering and evaporating the filtrate; 2nd, Cholestophane (the nitro-thèine of Stenhouse); obtained by the *prolonged* action of chlorine or nitric acid; and, 3rd, Murexoin, obtained by the action of ammonia on amalic acid. These bodies are homologous with alloxantine, parabanic acid, and murexid (compounds obtained by similar processes from uric acid), and differing only from these latter by having equivalents of the radical methyl (C_2 H_3) in the place of an equal number of equivalents of hydrogen. The following diagram will show this at a glance:

Alloxantin . .	$C_{16}\,H_4\,N_4\,O_{14}$
Parabanic acid . .	$C_6\,H_2\,N_2\,O_6$
Dimethyl-alloxan-tin or amalic acid .	$C_{16}\,(C_2\,H_3)_4\,N_4O_{14}$
Dimethyl-parabc. acid, or Cholestophane	$C_6\,(C_2\,H_3)_2\,N_2\,O_6$
Murexid	$C_{16}\,H_8\,N_6\,O_{12}$
Dimethyl-murexid Caffeo-murexid, or murexoin.	$C_{16}\,H_4\,(C_2\,H_3)_4\,N_6\,O_{12}$

The use of caffeine as an article of diet has not yet been satisfactorily ascertained. That this is a question of no mean interest is obvious when we consider that it exists in four substances differing widely from each other in their botanical origin, and yet all instinctively used for the same purpose by the various nations of the world, namely the production of useful and agreeable beverages. Liebig suggests that it contributes to the formation of taurine, a compound peculiar to bile. He considers bile to be one of the products of the decomposition of animal tissues, and has lately found caffeine in muscular flesh. Lehman has found that its administration is always followed by a slight augmentation of the secretion of urea.—*English Cyclopædia.*

MEDICAL PROPERTIES OF TEA.

The botany of tea is given under Thea, its chemical properties are noticed under Caffeine; for an account of its culture, see Notes on Tea.

Before attempting to estimate the action of tea on the human system, it is necessary to call to mind that some of the effects are due to the plants mixed with the real tea, several of which, such as the *Chloranthus inconspicuus*, are stimulants of the highest order; and in other instances deleterious chemical compounds are used by the Chinese to convert damaged black teas into saleable green teas. (Davis, 'Chinese,' ii. 466.) For the effects of these, tea is not justly chargeable A correct estimate of the action of

tea is not easily formed; yet the most dispassionate inquirers regard it as narcotic, the stimulating period of which is the most conspicuous and of longest duration. Tea has been preposterously praised by some writers, and unjustly accused by others as being productive of numerous diseases: above all it has been charged with causing an increase of nervous diseases. It would perhaps be more just to attribute the increase of such complaints to the more complicated state of our social relations, arising from an augmented population, and an advance in luxury, with the more frequent infringement of the natural laws, particularly turning night into day, and not seldom day into night, as is the practice of the votaries of fashion. That tea should not suit all constitutions or all ages is not remarkable. It is less suited for young children than for adults; indeed for very young children it is extremely improper, producing, like all narcotics, a morbid state of the brain and nervous system. It is also unsuited for those of an irritable nature, and likewise for those of a leucophlegmatic constitution. Such persons can ill bear much liquid of any kind, particularly in the evening, and prosper best on a very dry diet, to which growing children of this constitution should be strictly confined. It may not be true that the use of tea, as alleged by Dr. Lettsom, has been the main cause of the increase of scrofulous diseases; still as diseases of this class are the only diseases which are proved by the reports of the registrar-general to be stationary, or perhaps more frequent than others, whatever impairs the nervous power and ultimately the digestive function in strumous children should be avoided. His advice is sound where he says, "It ought by no means to be the common diet of boarding-schools; if it be allowed sometimes as a treat, they should be at the same time informed that the constant use of it would be injurious to their health, strength, and constitution." Those to whom it is most suited are the plethoric and sanguine. Upon the same principle it is a proper article of diet, and perhaps the best common drink at the beginning of fevers and inflammatory complaints. In a peculiar state of brain termed by Mr. Newnham ('Observations on Medical and Dietetical Properties of Green Tea') *sthenic excitement*, a state clearly bordering on inflammation, especially if produced by alcoholic stimulants, or by intense and long-continued application of mind to any particular object of literary research, green tea acts as a salutary remedy. On the contrary, in states of diminished excitement, morbid vigilance and nervous disturbance follow its use. It is not an uncommon practice with ardent students, when pushing their studies far into the night, to resist the claims of nature for repose, and keep themselves awake by the frequent use of tea. That it answers the purpose at the time cannot be denied, but the object is often attained at a fearful price, the destruction of health and vigour both of mind and body being the penalty. But more effect is produced by small doses, frequently repeated, than by large ones. See the paper on the 'Uses of Tea in the healthy System,' read before the Society of Arts, 15th February, 1861, p. 188. Dr. Smith's remarks are based upon a most extensive series of experiments—the results of which are most important. Less injury results in these cases from the use of coffee. There is this difference between the morbid states of the nervous system pro-

duced by coffee and those resulting from tea: that the former generally subside or disappear entirely on relinquishing its use; those from the latter are more permanent, and often incapable of being eradicated. Nevertheless many persons have immediately found their health improved by entirely relinquishing the use of tea, or even omitting it only at breakfast, for which meal it is certainly less proper than for the evening beverage. Those for whom tea is unsuited will generally find weak cocoa the most proper substitute.

Persons of a gouty and rheumatic nature, above all, those prone to calculous diseases of the lithic acid, diathesis, find weak tea the least objectionable article of common drink. They should take it without sugar, and with very little milk. (Prout, 'On the Stomach,' p. 217.) Where the water is hard, the addition of carbonate of soda not only improves the tea, but renders it a more proper beverage for such persons. This addition of an alkali seems to increase the action of tea upon the skin, and to augment its cooling properties. Cream appears to lessen the action on the skin, as does also lemon-juice. (Smith, *ut supra*, p. 189.) Tea should not be used till about four hours after any solid meal.

The medical uses of tea are not many. In fevers it is not only an excellent diluent at the commencement, but a tincture of tea made by macerating tea in proof-spirit, and adding a teaspoonful of this to a small cup of water, and given at short intervals during the night, after the acute symptoms have subsided, is often of great service. For this purpose, in hospitals and workhouses, the leaves which have been used for the ordinary infusion may be macerated in alcohol, and a spirit of sufficient strength for this purpose obtained at a cheap rate.

In some forms of diseased heart tea proves a useful sedative. It is nearly as valuable an antidote to poisoning by opium as coffee is. Some cases of poisoning by arsenic and tartarised antimony have been prevented proving fatal by the immediate administration of tea in the form of a very strong infusion. Here its power as an antidote depends upon its tanin decomposing the poisonous substances. But in poisoning by opium it is useful only in combating the secondary symptoms, and should not be administered till the stomach pump or other means have removed the opium from the stomach. Some cases of severe nervous headache are relieved by a cup of strong green tea, taken without milk or sugar. But this should be sparingly resorted to; it is a wiser plan to avoid the causes of such headaches. Tea has been looked upon as the great means by which intoxication was to be banished, but it is certain that to relieve the tremblings and other unpleasant effects of the abuse of tea, a little brandy or other alcoholic stimulant is occasionally added to the cup of tea, and so a habit is acquired which can never afterwards be relinquished.

Tea has frequently been denounced as a useless article of diet to the poor, as it is assumed to be devoid of nutriment, and the milk and sugar which are added are supposed to be the only beneficial ingredients. Dr. Lettsom has given a calculation, partly his own, and partly taken from 'Essays on Husbandry,' to show how much is, in his view, unnecessarily expended by them in this way. But the observations of Liebig are thought to offer a satisfactory explanation of the cause of the great partiality of the poor, not only for tea, but for tea of an expen-

sive and therefore superior kind:—"To see how the action of caffeine, asparagine, theobromine, &c., may be explained, we must call to mind that the chief constituent of the bile contains only 3·8 per cent. of nitrogen, of which only the half, or 1·9 per cent., belongs to the taurine. Bile contains in its natural state water and solid matter, in the proportion of 90 parts by weight of the former to 10 of the latter. If we suppose these 10 parts by weight of solid matter to be choleic acid, with 3·87 per cent. of nitrogen, then 100 parts of fresh bile will contain 0·171 parts of nitrogen in the shape of taurine. Now this quantity is contained in 0·6 parts of caffeine; or $2\frac{8}{13}$th grains of caffeine can give to an ounce of bile the nitrogen it contains in the form of taurine. If an infusion of tea contain no more than the $\frac{1}{10}$th of a grain of caffeine, still, if it contribute in point of fact to the formation of bile, the action, even of such a quantity, cannot be looked upon as a nullity. Neither can it be denied, that in the case of an excess of non-azotised food and a deficiency of motion, which is required to cause the change of matter of the tissues, and thus to yield the nitrogenised product which enters into the composition of the bile; that in such a condition the health may be benefited by the use of compounds which are capable of supplying the place of the nitrogenised substance produced in the healthy state of the body, and essential to the production of an important element of respiration. In a chemical sense—and it is this alone which the preceding remarks are intended to show—caffeine, or theine, asparagine, and theobromine, are, in virtue of their composition, better adapted to this purpose than all other nitrogenised vegetable principles. The action of the substances, in ordinary circumstances, is not obvious, but it unquestionably exists. Tea and coffee were originally met with among nations whose diet is chiefly vegetable." (Liebig's 'Animal Chemistry,' p. 178.) These facts show in what way tea proves to the poor a substitute for animal food, and why females and literary persons, who take little exercise, manifest such partiality for it. They also explain why the attempts, and they have been numerous, to find among other plants a substitute for tea, have invariably failed of success.

Dr. Thudicum, in 1869, made experiments on the production of new beverages from tea. By treating a decoction of tea with yeast and sugar, he produced many kinds of tea-wine, differing according to the proportions in which the constituents were combined. Another change was produced by adding a little alcohol; an effervescent wine resulted from forcing carbonic acid gas into the decoction; and another from the addition of an effervescing wine to the tea-liquor. A drink called *robur* or *tea-spirit* has recently been introduced, made by adding tea-decoction to whisky or brandy.—*English Cyclopædia.*

NOTES ON TEA.

Though now so extensively employed, the introduction of tea into Europe is of comparatively recent origin. Macpherson, in his 'History of European Commerce with India,' states that "tea (sah) is mentioned as the usual beverage of the Chinese by Soliman, an Arabian merchant, who wrote an account of his travels in the East about the year A.D. 850;"

but that he had been unable to find any other mention of it prior to the times of the Jesuit missionaries, who entered China and Japan a little before the middle of the 16th century. Anderson, in his 'History of Commerce,' quotes Botero as giving the earliest account in 1590, when he says that the Chinese "have also an herb, out of which they press a delicate juice, which serves them as drink instead of wine." Texeira, a native of Portugal, about the year 1600, saw the dried leaves of tea at Malacca; and Olearius found them used in 1633 by the Persians, who obtained them from China by means of the Usbeck Tartars. Tea, coffee, and chocolate are all mentioned in an Act of Parliament of 1660, whereby a duty of 8*d.* is charged on every gallon of chocolate, sherbet, and tea made for sale. But the use of it in England at that time must have been new; for Pepys in his 'Diary,' writes, September 25, 1661: "I sent for a cup of tea (a Chinese drink), of which I had never drank before." The Dutch East India Company probably first introduced it into Europe, and from Amsterdam it was brought to London. But tea must have continued to be brought in small quantities only; for in the year 1664 the East India Company purchased, for the purpose of presenting to the king, 2lbs. and 2ozs. of tea; and in the year 1678 they imported 4,713lbs. of tea, which was then for the first time thought worth their attention as a branch of their trade.

The Assam tea-plant first attracted public attention in 1834, in consequence of replies to the circulars which had been addressed to several gentlemen. Captains Jenkins and Charlton, in May of that year, wrote that a kind of tea-plant was undoubtedly indigenous in Assam. Since then it has appeared that several gentlemen were well aware of the fact, and also that Mr. David Scott had, in June 1825, sent leaves and seeds of a plant discovered originally by Major Bruce, which he said the Burmese and Chinese concurred in stating to be wild tea. A scientific deputation, composed of Dr. Wallich and Messrs. Griffith and MacClelland, was sent for the proper investigation of Upper Assam. Tea plantations were subsequently established, and Mr. Bruce was appointed their superintendent. Mr. MacCleland states that the tea tracts are found in Assam, first on the level plain, and secondly on mounds or hillocks, and that the former situations have a porous structure which enables them to maintain a dry surface under exposure to excessive moisture. Assam teas were first sold in 1839; and from the excitement and competition created by the novelty of the sale, such extravagant prices were paid as from 16*s.* to 34*s.* a pound; but they in due time found their true level.

Recent explorations have rendered it probable that the tea-plant is growing wild in the forests and jungles of Upper Assam, the Sylhet Hills, the Himalaya, and the great range of mountains extending thence through China to the Yang-tse-Kiang.

The subject of the *adulteration of tea* has occupied a large amount of attention within the last few years. Irrespective of any adulteration, however, the value of tea varies enormously, according to its delicacy and aroma. Mr. Wray, when at Malacca, had a small quantity of "Mandarin tea" given to him by some Chinese merchants; it is a kind never sold to foreigners, but commands 50*s.* per lb. in China itself. The vast bulk of tea used by the

Chinese is of poor quality; and much of the poorest is mixed to adulterate the better kinds for the English market. Mr. Wray estimates that the Chinese consume 2,000,000,000lbs. of tea annually, more than ten times as much as they sell to all other countries. When the English tea trade with China was wholly conducted by the East India Company, it is believed that the sophistication mostly took place after the tea reached the hands of other dealers; but now the Chinese adulterate it themselves. Mr. Wray states that seven-eighths of all the tea shipped from China in 1859 was adulterated; this was publicly announced at a meeting of merchants, held in Canton in April, 1859, to consider the subject. The adulterants were found to be: spent tea-leaves from some of the provinces, unsound leaf from others, and three or four sorts of plants. When brought to this country, the tea sold at a (nominally) low price in the poorer neighbourhoods, undergoes a still further process of adulteration. This is proved, not only by the analyses of Drs. Hassell and Letheby, and others, but also by the Excise seizures which so frequently occur. All admit that imitations of good tea can be produced by very easy means; and this facility offers a perilous temptation to dishonest persons.—*English Cyclopædia.*

THE ORIGIN AND FUTURE PROSPECTS OF TEA IN INDIA.

BY SAMUEL BAILDON, AUTHOR OF "TEA IN ASSAM."

NEARLY sixty years ago, when the disputes between England and China regarding various articles of export became frequent, anticipating a serious rupture in business relations, and a stoppage of the China trade, the English Society of Arts offered its gold medal or fifty guineas to any one "who should grow and prepare the greatest quantity of tea of good quality, not less than twenty pounds," in the East or West Indies, or any other British Colony. Although this offer was repeated for many years, no notice appears to have been taken of it until nearly twenty years after, when it became known through the East India Company that tea had been grown in India, and the Society of Arts gave its medal to the gentleman mentioned as having merited the reward.

The discovery of indigenous tea in Assam is generally believed to have been the origin of the tea enterprise in India, and the first occasion of its being known that tea would grow in this country. But according to a recent journal of the Society of Arts, this was not the case. A hundred years ago, the ships of the East India Company frequently brought the tea plant to this country, as a curiosity. Colonel Kyd, a resident of Calcutta, and who was well known for his botanical pursuits, had the tea plant growing in his garden in 1780. This gentleman corresponded with the famous Sir Joseph Banks; and in 1782, Colonel Kyd's garden was made over to the Calcutta authorities, and formed the foundation of the now well-known Botanical Gardens. Writing to Sir Joseph Banks, Colonel Kyd says: "The tea plants received from Canton have thriven well, although in most unsuitable soil and climate; the supercargoes are blamed for having sent only the worst sort,

which are never prepared for the European market, and refusing to procure native cultivation at the requisition of the Bengal Government."

In 1780, Governor-General Warren Hastings, writing to Mr. George Bogle, who was just leaving Bhootan for Thibet, "sends him some seeds of Hyson tea, to aid his benevolent plan of introducing the luxuries and excellencies of our world into that of Bhootan."

Other traces have been found proving the existence of the tea plant in India about this time, and also of the question of its acclimatisation being discussed: but no lasting result appears to have followed, until 1788, when Sir Joseph Banks, at the request of the East India Company, drew up a statement for the information and guidance of the authorities, with a view to improving the production of several agricultural staples, then occasionally grown but badly managed. The most important one was tea. Mr. Burrell, of the Society of Arts, has found in the British Museum the copy of a special communication on this subject, dated 27th December 1788, the original of which was sent from London to Bengal, requesting that it should receive the attentive perusal of the authorities there, and asking that, after procuring the best information, they would give the Directors "their sentiments at large, in a point of view both political and commercial." The Bengal Government referred to Colonel Kyd, who heartily coincided with Sir Joseph Banks; and this fact alone appears to have been sent home, without the special information and views particularly asked for. Probably the question was discouraged, as it presented a possibility of a rival to the China tea trade, which was a source of much wealth to the East India Company, as they enjoyed the monopoly of the article until 1833.*

Possibly this reserve on the part of the Company was the cause of the lull which occurred in the question after Colonel Kyd's death, until the discovery of indigenous tea in Assam. The date of this, together with the name of the actual discoverer, must always remain in doubt. The discovery has been attributed to a Mr. C. A. Bruce, who is reported by some to have traded in Assam, by others to have commanded a division of gun-boats in Upper Assam, during the first Burmese war; and to have brought down indigenons plants and seed in 1826. It is known that Bruce received a medal from the English Society of Arts on this account. A native named "Moneram Dewan" is credited with having been the discoverer. Bruce's claim was disputed by a Captain Charlton, who maintained that the existence of tea in Assam had been first established by him in 1832.† In 1834 a Committee was appointed to enquire into the possibility of cultivating tea in India. In 1835 Government made the first attempt, by establishing an experimental garden at Lakhimpore (Assam). It failed, and the plants were removed to Jaipore, where a garden was made, and sold to the Assam Company in 1840. This, the first Tea Company in India, was established about 1839. Tea in India was a new thing; India was too far off in those days; Assam was a place no one had scarcely ever heard of, and consequently the first days of the Company were not very prosperous. By 1850 many gardens had been made in different districts; and in 1853, a Mr. Mills visiting

* Extracts from "British Mercantile Gazette," February 1877.

† See Mr. Rainey's letter.

Assam found three private gardens in Sibsagar, and six in Lakhimpore. In 1854, the first gardens in Kamroop and Durrung were started. In 1855 indigenous tea was found in Cachar, and the first garden in that district was commenced in the cold season of the same year. In 1856, Tea was discovered in Sylhet, but no gardens were started until some time after.* Kumaon started tea planting about 1850, Darjeeling 1860, Neilgherries about 1862, Chittagong 1864, and recently Chota Nagpore in 1872, and Ceylon about the same year.

By 1839 it was an established fact that India was a fair field for tea. Samples of the first manufacture were sent to the East India Company in London, who forwarded a portion to the Society of Arts, asking for a report on the same. Amongst other active members were many well-known Mincing Lane men—Messrs. Thompson, Twining, and others, who kindly offered their opinion, and experience on the subject for the extension of trade. The samples were reported upon as being of superior quality, the infusion of a deep, rich red, of pungent flavor, and resembling the Pekoe of China. This was forwarded to the India House, and the East India Company's Directors, considering it so important, sent copies to this country for the guidance and more complete manufacture of future crops. In 1840, a second report was furnished by the above members of the Society of Arts upon other samples received, which stated that "Indian tea possessed all the richness, strength and flavor of the very finest kind imported from China; that the preparation now excelled every expectation that could have been formed of improvement in so short a time; and that India unquestionably possessed every requisite of soil and climate for producing teas of the finest quality."

The new enterprise gradually gained favor in the commercial circles, and money was forthcoming for opening out land. From about 1850 until 1865, tea was increasing in India. Slowly at first, treacherously rapid at last: and then the crisis came. There are two or three phases to this question. Land had been taken up for tea to such an extent, and so many gardens had been started, that seeing tea investments taken up so readily, most people very naturally thought it was a wonderful thing to pay. In a style it was. Not so much from the tea that was made, but by the money realised for seed. Gardens being opened out in large numbers, increased considerably the demand for seed. It was selling at Rs. 200 per maund. Now, growing seed is a very easy thing—planters are often forced to do this when coolies are scarce—and considering the little labor necessary to look after bushes left for the purpose, and the price just mentioned being obtained for what had cost scarcely anything, it can readily be understood how gardens showed great profits, and paid large dividends. It was this unusual interest on money invested which attracted the notice of capitalists; and people believed they had only to put the seed into the ground anywhere, and reap fabulous results.

It is a subject for regret, and one which cannot be denied, that the crash in tea was in a measure due to the dishonest practices of sundry "tea concern promoters." Estates were sold at many times their value, false representations were made as to existing arrears, and the actual state of affairs generally discovered too late. Men to manage gardens were recruited from anywhere; ordinary seamen and cap-

* Report, "Assam Administration," 1875-76.

tains, professional men, others who had failed in everything else, all —nearly all of them as ignorant regarding the industry they were entering, as could have been the case; gardens were made in places where tea was the last thing to plant; extravagance was indulged into the fullest extent: and so the end came.

I have been informed of a case where a few small estates were amalgamated and sold to a Company in London, and the "promoter," finding people red-hot to invest in tea, considered it a good time for making a private harvest, and in the particulars of the then estates he included and actually sold a 100-acre garden which had no existence: writing to his representative next mail to buy seed at any price, clear and scrape something near 100 acres, and plant the seed: *as it had been sold.* Sundry mercantile men in Calcutta were convicted of boiling the tea-seed after it was sold, to prevent its germination, and to retard the success of the purchasers who were embarking in tea. Another practice, when it became known that tea did not usually yield until three years old, was to reckon the year (or thereabout) which the seed had taken to mature from the blossom on the parent bush, so that when it was planted the garden was "one year old."

These and many other similar practices principally caused the crash of 1865-67. What has been said about ignorant managers, every one in tea at the time will corroborate. Not that all managers were thus; but considering the sudden influx of new men to the tea districts, the number of old ones being comparatively small, the majority of (so-called) planters were found to be useless and ignorant. Men who knew nothing of their work being put to manage affairs, it is not difficult to understand that an article scarcely deserving the name of tea was abundantly made. Old planters, whose names and marks were well-known in the market, were forgotten or overlooked in the sudden flood of rubbish that was sent for sale. I have seen sale lists of the market at this time. Pekoe 1*s.* 3*d.* per lb., Souchong 10*d.*, Broken Teas 3½*d.* @ 6*d.* per lb. Many estates had been purchased with borrowed money, and the seed sales having declined, no adequate return was given by the crops which realized such prices as these. Such was the past of tea.

It is a well-known historical fact that great calamities are invariably followed by much real good. This was seen in the Plague of London, which, although terrible whilst it lasted, caused an investigation into the sanitary arrangements of the great city, and subsequent improvements. The same with the Great Fire. When the unhealthy, ill-ventilated buildings, which previously principally formed the city, were burnt down, the very natural enquiry came, how was it they had all taken fire so readily? The evil worked much good. So it was with tea. Very great and grievous were the losses; but good came of the evil. Tea-planting has become a science now; and, although many managers scarcely regard this fact,—working like machines, because they have been so instructed,—the force of good example ensures better results than formerly. *Gardens* are made—indifferent seed is no longer thrust into an imperfectly cleared patch of land. Men as ignorant as those previously at the head of factories no longer get charge of them, and the market receives tea (not rubbish as formerly)—tea which is surely making its way.

In 1840 the first tea garden in

India (a very young one) was sold. Thirty-seven years after, what do we see? Hundreds of thousands of acres of land taken out of jungle and planted with tea. In this short time many districts have been opened out:—

Assam.	Debra Doon.
Cachar and Sylhet.	Kumaon.
Chittagong.	Neilgherry Hills.
Darjeeling.	Chota Nagpore.
Kangra.	Ceylon.

The growth of the tea industry during the (say) forty years of its existence is simply astounding.

A question naturally asked is: If the supply has increased so wonderfully, has the demand? We answer "Yes." Not that Indian tea is appreciated by itself by the tea-drinking public, for many of them would be horrified at the idea of changing the beverage they have drank all their lives, *id est* China tea (according to the common belief). Indian tea is very seldom taken alone, excepting by persons who know exactly what they are doing. I think I may safely say that almost every one who has occasionally drank really good Indian tea prefers it to any China tea. It is undoubtedly far superior. The industry in China, although a very considerable one, fails to carry that earnest importance with it to persons engaged in it, that tea in India does. According to writers on the subject, where nothing else will grow remuneratively in China tea is planted. Land is taken up for this purpose by the Chinese, as it is in India for paddy. Natives grow the leaf (sometimes manufacture it), and sell it to the European firms for shipment. In India, with very few exceptions, what tea a planter ships he has himself grown, and its cultivation and manufacture has received the benefit of all his care, attention, and anxiety,—that it may be as good as possible. The fact that soil in Indian tea districts is much richer than in China, would, of itself, make the article better. In addition to this, the indigenous Indian plant is of a far higher class than the China one. The intrinsic value of Indian tea is very plainly shown by the price it realizes—crops from the two countries bear no comparison to each other in point of average price obtained. I have seen China Congou sold in the London sale rooms at 4*d.* per lb. I think I can safely say, that no tea which leaves India now, fetches so little.

Another proof of the superiority of Indian tea is the purpose for which it is used. China tea generally has more fragrant aroma (obtained from various flowers,) than strength. Indian tea is used for supplying the absent quality, and this is the article the British public are drinking to-day, content with the old China tea (as they believe it,) and scouting the idea of tea from any other place under the sun as a "new fangled notion." Persons using Indian tea at home alone, report it as being far more economical than China tea: and whilst a much smaller quantity suffices ordinary purposes, there is, notwithstanding the reduction, a decided improvement in strength and body. Wholesale and retail men know the value of Indian tea now, and I believe there is scarcely any China tea sold at the present time, without a considerable addition of the Indian article. The consumption of Indian tea is not confined to this country and the United Kingdom. In "How I found Livingstone," Stanley narrates that arriving at one place (Unyamyembe I think) he was entertained by some travelling merchants with "the fragrant decoction of an Assam herb." This was right away in inner Africa. It

should be remarked that, as a rule, *all Indian teas are known by the one* name of "Assam." The Central Asian traders are buying tea from Kumaon; in fact from the gardens of the Himalayan districts generally. It may not be generally known, but it is nevertheless a fact, that the best of the China tea crop never reaches the United Kingdom. It is (and has been for years) always bought up by the Russian Agents immediately they can place their hands upon it. Russia is a great tea-drinking country. Who knows, but that Indian tea may obtain the precedence there too, as in other places. It may be so, although I have heard that obstacles are placed by the Russian Government in the way of the successful introduction of Indian tea to that country; for, although samples have repeatedly been submitted, they have never got beyond the Russian Custom House. This, however, might be overcome.

To illustrate the present state of the commerce in Indian tea, I cannot do better than give an extract from the annual tea circular for 1876 from one of the leading London houses:—* "The Indian tea trade during the past year (1876) has been uninterruptedly prosperous, for the greater imports have been followed by a proportionate increase in the use of Indian tea, which now, indeed, forms not far short of a fifth of the whole consumption, while the larger supplies have been disposed of at rates highly remunerative to planters. During the last ten years the weight exported from India has risen from 2,500,000lbs. to 28,126,000lbs.—an increase of over eleven times; and while the next crop is expected to yield 36,500,000lbs., it is generally thought that the great extensions of the gardens, caused by the profitable character of the trade during the past few seasons, will, within a few years, lead to an export of 60,000,000lbs. *If the present* promise for the *coming* season be maintained, it appears probable that we shall receive 34,000,000lbs. during 1877, and if the increased imports be consumed, as there seems little doubt that they will be, Indian tea will form about one-fourth the consumption. Many of the leading and keenest grocers now use one-half of Indian tea in their mixtures, and are thus enabled to buy lower priced China teas. By this course they are able to offer a better tea than their neighbours, and the public, who still adhere to the traditional tea-spoon as the measure of the quantity to be infused, do not, as might be thought, diminish their consumption, but congratulate themselves on getting more strength and flavor for their money. Some progress has also been made in the retail sale of unmixed Indian tea. But as the flavor is so totally different from that to which the public are accustomed, the planters can only expect a very gradual advance in the use of their tea by itself, for which, however, the increasing quantity used in mixing is gradually educating the nation."

The following figures will show the surprising development of the consumption of Indian tea in the United Kingdom during the last few years. The percentage is against the amount of China tea actually consumed in Great Britain and Ireland, and does not refer to the total importations:—

1861	1,250,000lbs.	equal to	1	per cent. of the total consumption.
1864 ...	2,500,000lbs.	„	2½	ditto.
1867*...	6,000,000lbs.	„	6	ditto.
1870 ...	13,500,000lbs.	„	10	ditto.
1874 ...	21,000,000lbs.	„	15	ditto.
1875 ..	24,000,000lbs.	„	17½	ditto.
1876 ..	27,000,000lbs.	„	19	ditto.

The anticipated yield of Indian tea during this year is 36,500,000lbs.,

* Messrs. Travers & Co.

* Duty on tea reduced to 6*d*. per lb.

from which about 2½ millions have *to be deducted for local consumption, waste, and export to other parts, leaving a balance of 34,000,000* lbs. for the United Kingdom: about a fourth of the total amount consumed annually at the present time, equal to the whole consumption in 1841, and half of that of 1857, when the reduction in duty caused a greatly increased consumption. The production of tea in the different districts of India is roughly this:—

Assam	50 per cent.
Cachar and Sylhet	25
Darjeeling	13
Kangra, Kumaon, and Dehra-Doon	10
Chittagong, Chota Nagpore, and Neilgherries	2 „
TOTAL ...	100 per cent.

Beyond a doubt, these proportions are but a fraction of what India is actually capable of doing. If the present area under tea were filled with plant, and thoroughly cultivated, an additional 25 per cent. all round might be added to the present exports from the existing acreage. Beside, too, there is a great quantity of young tea especially, I know, in Assam and Cachar, which will be adding fair figures to the present total in a year or two. There is land in India sufficient not only to supply the requirements of the United Kingdom, but the wants of the whole world: thousands of acres scattered about from Cape Comorin to the Himalayas.

Indian tea has always realized the highest prices in the London market. In 1876, the average price per lb. of Indian tea in bond was 1*s*. 11*d*., whilst that of China was only 1*s*. 3*d*. Another proof of the value of Indian tea over China is shown by the statistical tables of the Board of Trade, that the declared value of Indian tea received during 1876 was 2½ million pounds sterling, and that of teas from China, Japan, and all other sources was ten millions; *so that whilst the quantity of Indian* tea was only 19 per cent., its value *was equal to 25 per cent. This shows that the average exports from* India are of a superior quality to those of China and elsewhere.

Notwithstanding that all Indian teas have found a ready and remunerative sale in England, they have been used by the general public, so to speak, without people being aware of it. From the faintest possible addition with China tea at first, it is now boldly used: the tea-drinking populace are satisfied with the combined strength and flavor; the retail dealers too, because the better the quality of Indian tea they obtained the lower and cheaper the China. The excess cost of one is worked off by the deduction in that of the other: the public is satisfied, and Indian tea at all events finds a ready sale.

Another thing which must be considered highly satisfactory, is the desire to effect improvements in all branches of the tea industry. Machinery ranks first—an agent not likely to be weakened by a bad climate, and one which (where hand manufacture formerly was) makes an insufficient labor staff ample. Skilful men have charge of gardens now. Instead of tea being a refuge and last resource for the comparatively destitute, as it was not many years since, it is now looked upon as a profession of a high order, and into which men of the highest social rank are entering.

Districts hitherto deadly, because of the unopened country, are fast becoming as salubrious as good tea districts can be; coolies in consequence are keeping fair health, instead of dying off like sheep, and are raising up a lasting supply of juvenile blacks, who a few years hence will suffice the labor requirements of moderate-sized gardens.

Now comes the most important question—the *future prospects.* There are many very serious considerations connected with this. Planters and proprietors of tea estates in India are to be congratulated upon the valuable co-operators they have in England, to whose manifest advantage it is to do all in their power for the furtherance of the Indian tea interest. Considering that exports from this country will probably form a fourth of the total consumption in the United Kingdom during the current year, it is not a difficult matter to understand that were Indian tea to fail, the London Brokers and Merchants would be deprived of a very considerable portion of their present business. Retail men, too, would lose largely, and the general public be disappointed at the change in its favorite beverage. The first and most important consideration is, whether the present demand for Indian tea will continue and increase. According to the report of the firm I have previously quoted, there is no reason to doubt this. Inasmuch as the demand has been steadily increasing for the last few years, it is quite reasonable to expect a continuance of it. There is, however, a question of the gravest nature connected with this. To continue the confidence people have in Indian teas at the present time, and with a veiw to increasing the same, nothing but pure, unadulterated tea must be made in this country. Whilst China alone supplied the world with tea, crying out against the well-known practical adulterations was a comparative waste of time. But when India commenced to compete with China, and to ship nothing but pure teas, the authorities in England made public the disgraceful practices of the Chinese tea exporters. The principal excellency of Indian tea has always been its known purity. Once let a doubt upon this come before the commercial world at home, and the good name of tea from here will rapidly fall

With the difference in the management of the tea industry in this country—I mean its being under the direct supervision of competent Europeans—a thorough and proper manipulation of the leaf should leave no room to improve its appearance by adulteration. It is this fact which should inspire confidence in persons having investments in tea. India has made wonderful strides in this direction, and this is principally due to the "go-aheadedness" (to coin a word) proverbial in "John Bull." The local strife of one planter with the other, suffices to keep every conscientious man up to the mark to do his best. So long as the English merchants have confidence in the integrity and competence of the tea planters of this country, we may rest assured that, having themselves a large stake in it, the brokers will push the common interest as far as they possibly can. If our tea deteriorates, the demand cannot continue. Indian tea is like a child striving against a giant; and it behoves all planters to do their utmost to defeat the monster (China) by hook or by crook, noticing all the defects and weak points in him and striving to prevent a similar appearance in Indian tea. It is only natural to expect, that seeing the standing India has thus far rapidly obtained in the tea market, China will endeavour to make a fresh start to regain its lost ground. It would require much more motive power even to render seriously shaky and old establishment like China tea than it would to annihilate the whole industry in India. Japan, too, is assisting China, and making rapid strides in the tea world ; so that we

in India have an old enemy and a robust new one to fight against. Only by the greatest care, honest straightforward dealing, and a determination on the part of every one in any branch or department to do his best, can India hope to compete successfully against such odds. In the past we have been signally successful. The crisis taught a lesson; we have manifestly profited vastly by it. The slightest slip would send us back a long way, and retard our future progress very considerably.

Next to the absolute necessity of maintaining the standard of our teas, the greatest consideration is that of labour. We cannot longer close our eyes to this. The best way to commence meeting half way a very probable enemy, is for each planter to make the area of his garden, at present nominally under plant, entirely a yielding acreage, instead of launching into new extensions, involving liabilities for clearing land, which he will probably never have the labour to make into a garden. I regret to know, that even at this time, where the labour staff is totally inadequate to properly cultivate the present garden, orders are being constantly given to extend. A hundred acres of *plant* thoroughly cultivated is a far more satisfactory and lucrative property than 200 acres partially filled and badly kept. Although for tea itself, soil and climate call for the first consideration; the labour question should be put, I think, on the same level. A slightly inferior climate, with ample local labour, will give better results than the finest climate and soil, where the continual expenses of importing unacclimatized labour has to be incurred.

Whilst the demand for Indian tea calls for a resolute response to meet it, however great it may be, we must not rush blindly into suddenly flooding the market, because the chances are, that such hasty operations would be imperfectly performed, and lessen the considered value of Indian tea.

WHO FIRST DISCOVERED THE ASSAM TEA PLANT?

IT appears from the recently published Administration Report of Assam for the past year, by Colonel R. H. Keating, C.S.I., V.C., the Chief Commissioner of that Province, that there still prevails some uncertainty as to who really first discovered the existence of the tea plant in Assam;* and, as this subject has now attained in some sort of historical importance, it is as well to elucidate it fully and come to a decision in the matter once for all.

The rival claimants for the honor of the discovery were Mr. C. A. Bruce—I do not know whether he is yet alive or not—and the late Captain Charlton, of the Bengal Army; but the late Major R. Bruce, brother to the former gentleman, is, I believe, actually entitled to be considered the first who found the tea plant growing (in the District of Tezpore) in Assam, and this I shall be able to conclusively prove.

On the one hand, it is found that the English Society of Arts presented Mr. C. A. Bruce with a medal for discovering the tea plant in Assam. On the other hand, the Calcutta "Agricultural Society," according to Dr. John M'Clelland, (*vide* his Cal. Jour. Nat. His., 1842, Vol. II, page 430,) "in awarding its medal to Captain Charlton, the discoverer of the Assam tea plants, appears to have vindicated its own independence, and established that gentleman's claim to the discovery, etc." * *

The honor of discovering the tea plant in Assam is claimed for the late Captain Charlton on the ground that he found it in Upper Assam as far back as 1831, so that if any one can prove that he discovered

* It is there stated: "Its discovery has been attributed to a Mr. C. A. Bruce, who commanded a division of gunboats in Upper Assam during the first Burmese war, and who appears to have brought down from Upper Assam some plants and seed of the indigenous plant in 1826. He certainly received a medal on this account from the English Society of Arts. But his claims to have been the first discoverer of tea was disputed by a Captain Charlton, who asserted that the existence of tea in Assam had been first established by himself in 1832.

the plant in that Province at any time previous thereto, this officer's claims to the distinction would be altogether set aside.

Now, Mr. C. A. Bruce, in a letter dated the 20th December 1836, to the address of the Agent to the Governor-General, North-East Frontier, states: "At the breaking out of the Burmese war* I offered my services to Mr. Scott, then Agent to the Governor-General, and was appointed to command gunboats. As my command was at Suddya, I was the first who introduced the tea seeds and plants, and sent them to Mr. Scott and other officers below." And the absolute correctness of this statement is fully borne out by the late Dr. N. Wallich, who wrote to the Agent to the Governor-General, in a letter dated the 15th March 1836, that it is "a fact to which the late Mr. David Scott has borne ample testimony."

Thus it is clearly established that Mr. C. A. Bruce found the Assam tea plant some years before Captain Charlton did so. But the late Major R. Bruce discovered the tea plant in Assam previous even to his brother, and this is satisfactorily proved by the candid admission of the latter himself. In his letter to the Agent to the Governor-General, North-East Frontier—previously quoted—he wrote: "My late brother, who was in Assam before the breaking out of the war,* had previously informed me of their"—the tea plants'—"existence."

It must, therefore, be concluded that the late Major R. Bruce was the first who discovered the Assam tea plants, and that honor should be awarded to him, who never sought for it.

I may add that I have obtained the facts given above from, among other sources, Professor Royle's "Productive Resources of India, London. 1840, pp. 297-281," and the article entitled "Tea Cultivation in India," given in the *Cal. Rev.* No. LXXX. I quote these authorities that others may consult them if they wish to do so, and satisfy themselves on all points here referred to.

In the *Cal. Rev.*, above alluded to, (p. 296), it is stated that the tea plant in Cachar was not discovered till 1855, and then "by a native, now a blind old man." What's his name?

Yours faithfully,
H. James Rainey.

Khoolnah (Jessore,)
May 17th, 1877.

*War was declared on the 5th May 1824.—H. J. R.

*This must have been previous to the above date.—H. J. R.

ANALYSIS AND CHEMICAL DESCRIPTION OF TEA AND ITS ADULTERANTS.

By A. W. Blyth, M.R.C.S., F.C.S.*

Varieties of Tea.—Tea is the dried leaf of different species of *Thea*, a section of the genus *Camellia*. The botanical varieties do not appear to be numerous. *Thea Bohea*, *T. viridis*, and *T. sinensis*, all Chinese, plants, *Thea Assamica*, indigenous to Assam, and one or two hybrids, are the principal plants from which the numerous teas of commerce are derived. The difference depends on the selection of young or old leaves, and special treatments in drying and otherwise preparing the leaf, rather than on essential botanical variation.

The varieties of tea imported into England are extremely numerous; but seldom does any one of them reach the consumer unmixed, for the wholesale tea merchants carefully improve their teas by "blending." The most common sorts are—Gunpowder, Hyson, Congou, Capers, and Indian tea. Of these, the Gunpowder and Hyson are dried at a higher temperature than the others, and contain less hygroscopic moisture. The Capers may be generally told by the leaves being rolled up into little lumps with starch or gum; as a class, they are much adulterated, and, in fact, can hardly be called genuine tea.

Besides these, there are a number of special teas, some of a very high

* Published by Chas. Griffin & Co., London, 1879.

price, and imported in a state of great purity, but such teas are used almost entirely for mixing or blending. They are known under the names of Moyone, Moyone Gunpowder, Oolong, Mannuna Kaisow, Scented Pekoes, Indian Souchong, Assam, Java, &c. The names by which the teas of commerce are most familiar to the public are simply "green" and "black," which differ merely in accordance with the method of preparation followed. Green tea is prepared from young leaves, which are roasted over a wood fire within an hour or two after being gathered. The black tea leaves, on the other hand, are allowed to lie in heaps for ten or twelve hours after they have been plucked, during which time they undergo a sort of fermentation; the leaves then pass through certain processes, and are slowly dried over charcoal fires.

Structure of the Tea Leaf.—The border is serrated nearly, though not quite, up to the stalk. The primary veins run out from the midrib almost to the border, and then turn in, so that a distinct space is left between them and the border. The diagnostic mark of a tea leaf is, however, the microscopic appearance of its epidermis, which, especially that of the lower side, exhibits numerous small stomata formed of two reniform cells of an average length of from ·0001328 to ·001662 inch, and average breadth ·001162 to 1000996 inch. Around the stomata are seen elongated and curved epidermic cells. This appearance, so far as is known, is met with only in the tea plant. Stomata are infrequent on the upper surface, the epidermal hairs are simple.

Chemical Composition of Tea.—The constituents of tea are—*Essential oil, theine, boheic acid, quercetin, tannin, quercitrinic acid, gallic acid, oxali acid, gum, chlorophyl, resin, wax, albuminous, woody and colouring matters, and ash.* The essential oil of tea varies from 0·6 to 1 per cent. It is citron-yellow, lighter than water, has a strong odour of the tea plant, solidfies easily by cold, and resinifies on exposure to air.*

Theine, Caffeine, $C_8H_{10}N_4O_2$.—This alkaloid was first separated in an impure condition by Runge, from coffee berries, in the year 1820. It was found by Corput and Stenhouse also to be a constituent of the leaves of the coffee tree. Oudry, in 1827, finding it in various species of tea, named it "Theine;" and Oudry's "Theine," Mulder and Jobst showed in 1838 to be identical with caffeine. The alkaloid has also been discovered in guarana, maté, and the kola nut, by Martius, Stenhouse, and Attfield respectively.

Theine crystallises from an aqueous solution with 1 atom of water; from ether, in an anhydrous state. It sublimes in minute dots at 78·8°C., in crystals at 76·4°C. (175°F.), and above.† The sublimate consists of microscopic needles: that which is first produced is of extremely fine, light elements; after a little time, at such temperatures as 120°C., the crystals become longer and larger. The melting point of theine is somewhere between 177°C. and 228°C. Theine possesses a slightly bitter taste, but is without odour. According to a recent research, the solubility of theine in different solvents is as shown in the following table.

* A fixed oil, serving many purposes in China, is extracted from the seeds of the tea plant. It is citron-yellow, specific gravity 0·927, and is composed of one part of stearin and one of olein.

† The subliming point given by Pelouse, 178°C., and by Mulder, 184·1°., must have been obtained by extremely faulty methods. If a little theine is placed between two watch glasses on the water-bath, the almost instantaneous rise of crystals to the upper glass will at all events show that the subliming point is below 100°. See the author's paper, "Temperature at which the Alkaloids sublime," *Journal of Chemical Society*, 1878.

Theine forms numerous salts of definite composition—the hydrochlorates, $C_8H_{10}N_4O_2$ HCl and $C_8H_{10}N_{42}O$, 2HCl; a platinum compound, $C_8H_{10}N_4O_2$, HCl, $PtCl_2$; a chloride of gold compound $C_8H_{10}N_4C_2$, HCl, $AuCl_3$; a chloride of mercury and theine, $C_8H_{10}N_4O_2$, 2HgCl; an argentic nitrate with theine, $C_8H_{10}N_4O_2$, $AgNO_3$, and many others. Some of these, such as the silver compound, separating from a concentrated watery solution, and the mercury compound, almost insoluble in ether, and capable of being dried at 100°C., might possibly be of use in the estimation of theine.

SOLUBILITY OF THEINE.

	100 grms. of Solvent at 15° to 17°C. dissolved of Theine. Hydrated.	Anhydrous.	Co-efficient of Solubility at 15° to 17° C. Hydrated.	Anhydrous.	100 grms. of Solvent at the boiling point dissolved of Theine. Hydrated.	Anhydrous.	Co-efficient of Solubility at the boiling point. Hydrated.	Anhydrous.
Chloroform, ...	...	12·97	...	1/7·72	...	19·02	...	1/5·25
Alcohol of 85 per cent., ...	2·51	2·30	1·40	1/43·4	...	...	...	...
Water, ...	1·47	1·35	1·60	1/74·3	49·73	45·55	1/2·01	1/2·19
Absolute Alcohol, ...	...	0·61	...	1/164·7	...	3·12	...	1/32
Commercial Ether, ...	0·21	0·19	1/476	1/526	...	0·454	...	1/220
Carbon Bisulphide, ...	...	0·0585	...	1/1709	...	...	...	...
Purified Anhydrous Ether, ...	...	0·0437	...	1/2288	...	0·36	...	1/277
Essence of Petroleum, ...	...	0·025	...	1/4000	...	...	...	...

Theine is, in large doses, a poison. Frerichs, C. J. Lehmann, Husemann and others, have made themselves the subject of experiment. Lehmann, after taking ·5 grm., suffered from frequency of the pulse, irritation of the bladder, cerebral excitement, slight hallucinations, and lastly desire to sleep. Husemann took ·25 grm. with somewhat similar symptoms. Pratt, with subcutaneous infection, of from ·12 to ·8 grm., suffered from symptoms rather different from the foregoing; ·3 grm. lessened the pulse and caused sleeplessness; ·4 to ·5 grm. quickened the pulse, and caused a desire for frequent micturition, but no dilation of the pupil; ·8 grm. caused great uneasiness and anxiety, trembling of the hands and arms, so that he was unable to write, and later a restless sleep, with continual dreaming. In opposition again to all these statements, is that of the late Mr. Cooley,* who is said to have taken 20 grains (1·29 grm.) of pure theine every day for a month without experiencing any other symptom than some slight elevation of spirits. According to Strauch, the least fatal dose for cats is ·25 grm., a quantity which killed a cat in 35 minutes. In all experiments on animals there has been increased frequency of the heart's action, and repeated emptying of the bladder and intestine. No case of poisoning in the human subject appears to be on record. When given to animals it has been chemically separated from the blood, urine, and bile.

Tests for Theine—Concentrated sulphuric and nitric acids dissolve theine in the cold without the production of colour. If the alkaloid is treated with fuming nitric acid, and evaporated to dryness, the reddish yellow residue becomes, when moistened with ammonia, of a splendid purple-red colour. If a solution of theine be evaporated with chlorine water in a watch-glass, a red-

* *Vide* Cooley's "Dictionary of Practical Receipts," Art. Caffeine.

brown residue is obtained, which, on cooling, and exposure to the vapour of strong ammonia, becomes purple-violet. The chief precipitants of theine are—phosphomolybdic acid, yellow precipitate; iodine with potassic iodide, dirty brown precipitate; chloride of plantinum, yellow hair-like crystals, insoluble in cold hydrochloric acid, slowly separating; chlorides of gold, mercury, and nitrate of silver also give precipitates.

Boheic Acid. $C_7H_{10}O_6$, was first separated by Rochleder in 1847,* from the leaves of *Thea sinensis*. The hot watery decoction of tea is precipitated whilst boiling by sugar of lead, filtered, the filtrate neutralised by ammonia, the resulting precipitate collected, suspended in absolute alcohol, and freed from lead by SH_2; the filtrate from the lead precipitate is evaporated to dryness in a vacuum, and purified by re-solution in water, &c. It is a pale yellow amorphous powder, melting at 100°C. into a tenacious mass, and decomposing at common temperatures if exposed to the air. It is soluble in all proportions in water and alcohol, is coloured brown (but not precipitated) by chloride of iron, and forms for the most part amorphous salts insoluble in water.

Quercitrinic Acid, $C_{33}H_{30}O_{17}$, first discovered by Chevreul and Brandt in the *Quercus tinctoria*, and stated by Hlasiwetz to be in tea leaves, can be crystallised from an aqueous solution. It forms sulphur or chrome-yellow microscopic tables, containing 3 atoms of water, part of which is expelled at 100°C., the rest at from 165° to 200°C. Its reaction is neutral, and it is without odour, but has a marked bitter taste when in solution. It melts at from 160° to 200° C. to a resinous, amorphous mass. Its solubility is as follows:—Cold water 2485, boiling 143; cold absolute alcohol 23·3, boiling 3·9; ether dissolves it slightly, warm acetic acid copiously. Sugar of lead precipitates almost completely; precipitate is soluble in acetic acid.

Quercetin, first obtained by Rigaud, 1854, from the splitting up of quercitrinic acid, is, according to Filhol, to be found in the green leaves and flowers of all plants. Its formula is given as $C_{27}H_{18}O_{12}$; it forms fine yellow needles, or a citron-yellow powder, which gives up at a temperature of 120°, 7 to 10 per cent. of water of crystallisation. It melts, according to Zwenger and Dronke, above 250°C. without decomposition, solidifying again in a crystalline mass, and it may be also sublimed with only partial carbonisation. It is very little soluble in water. Warm acetic acid dissolves it copiously, but it separates on cooling. Alcohol dissolves it: 229·2 parts of cold, 18·2 parts of hot and absolute, are required. A solution of quercetin colours linen bright yellow, sugar of lead precipitates the alcoholic solution cherry red, and chloride of iron dark red. A combination with sodium or potassium can be obtained, Na_2O, $C_{27}H_{18}O_{12}$.

The other constituents of tea, such as gallic and tannic acids, gum, &c., are too well known to need description.

ANALYSIS OF TEA.

We possess no complete analysis of tea; partial analyses are numerous. An often quoted one by Mulder is as follows:—

	Black Tea.	Green Tea.
Essential Oil, ...	0·60	0·79
Chlorophyl, ...	1·84	2·22
Wax, ...	0·00	0·20
Resin, ...	3·64	2·22
Gum, ...	7·28	8·56
Tannin, ...	12·88	17·80
Theine, ...	0·46	0·43
Extractive Matter, ...	21·36	22·80
Colouring substances, ...	19·19	23·60
Albumen, ...	2·80	3·00
Fibre, ...	28·33	17·80
Ash (Mineral substances,)	5·24	5·56

* Rochleder, *Ann. Chem. Pharm.*, lxiii. 202.

The theine here is certainly too low, but the amounts of the other constituents are a tolerably just representation of what may be usually found. Some partial analyses recently published by Dragendorff may be re-produced here, as probably the only extended and trustworthy researches on the amount of theine, the alkaloid having been extracted by a fairly reliable method. (*See annexed table.*)

COMPOSITION OF TEAS IN RUSSIAN COMMERCE.

	Price per Russian pound Rbs. Kop.	Water. Per cent.	Constituents soluble in water. Per cent.	Theine in percentage of Non-dried Tea.	Nitrogen. Per cent.	Tannic and Boheic Acids. Per cent	Constituents insoluble in water. Per cent.	Ash. Per cent.	Silica and Sand. Per cent.	Percentage of Ash, minus Silica and Sand.	Ash from insoluble Constituents. Per cent.	Potash. Per cent. [On the Tea.]	Potash. Per cent. [On the Ash.]	Phosphoric Acid. Per cent. [On the Tea.]	Phosphoric Acid. Per cent. [On the Ash.]	OBSERVATIONS.
1. Yellow Tea	3·	10·90	35·5	1·78	6·72	...	53·6	5·92	1·64	5·28	2·18	2·53	42·82	1·09	18·47	Length of leaf, 25 to 47 mm.; only a few entire leaves; buds of 8 mm. diameter.
2. " "	5·	7·10	41·1	1·61	...	...	51·8	6·12	0·35	5·77	1·99	...	...	...	...	Length of leaf 30 to 40 mm.; only a few entire leaves.
3. " "	6·	9·09	38·8	1·49	...	...	52·2	5·61	0·27	0·34	2·12	...	...	0·80	16·65	Many broken stalks, with folded undeveloped leaves; buds 3 to 5 mm. diameter; length of leaf 21 mm.
4. " "	8·	9·88	36·5	1·43	6·60	12·70	53·7	5·33	0·85	4·48	2·79	2·10	39·55	1·33	25·02	Buds and points of leaves still less developed; but few entire leaves.
5. Green Tea	2·50	8·35	33·5	1·82	6·02	...	58·2	6·82	0·85	5·97	2·74	2·27	33·40	0·79	11·65	Full grown, but not leathery leaves; most, it would appear, halved by design; absence of buds. No. 5 more compact than the others; coloured blue, and slightly rolled. No. 6 is in rolled little balls; No. 7 in cylinders.
6. " "	3·	8·82	39·9	1·66	...	12·32	51·3	6·21	0·98	5·23	2·50	...	...	0·72	11·67	
7. " "	4·50	7·92	37·5	1·61	6·01	...	54·6	5·78	0·58	5·20	2·04	2·48	42·99	0·77	13·32	
8. Black Tea	1·20	10·63	44·5	1·36	4·15	...	44·9	6·07	0·99	5·08	2·89	2·23	36·88	0·79	13·11	Mostly old leaves; much divided.
9. " "	1·40	10·25	32·4	1·79	...	...	57·4	6·51	0·83	5·68	3·68	...	...	0·93	14·30	Old leaves, but little powdered; mostly in halves. 11 and 12 are less compact than the rest, so that by a little soaking in water they are easily powdered.
10. " "	1·60	10·43	33·3	1·65	...	...	56·3	6·00	1·35	4·65	3·75	...	...	0·88	13·84	
11. " "	1·75	9·98	26·8	1·89	...	...	63·3	6·22	0·89	5·24	3·04	...	...	...	...	
12. " "	2·	9·47	30·7	2·08	...	9·42	59·9	5·62	1·19	4·43	3·19	...	...	1·03	18·42	
13. " "	2·20	10·70	27·2	2·11	...	...	62·1	6·18	1·11	5·70	...	...	...	1·14	18·54	Mostly not fully grown; halved; rather thin leaves.
14. " "	2·50	10·90	27·2	2·14	5·26	...	61·9	5·78	0·98	4·80	2·79	1·97	84·19	1·11	17·25	
15. Flower Tea (Blumen Thee).	2·20	9·46	29·1	2·12	...	...	67·5	6·15	1·03	5·12	2·69	2·28	37·94	0·88	14·42	Similar to the above; a few stalks as Nos. 3 and 4; No. 16 has somewhat more numerous stalks than 15.
16. " "	2·50	8·79	30·0	2·13	4·75	...	61·3	5·89	1·12	4·77	3·15	...	...	0·87	14·79	
17. " "	2·70	10·51	29·4	1·81	...	...	60·1	5·63	0·92	4·70	2·32	...	...	1·27	19·92	Cut, half-developed leaves; a few stalks and buds.
18. " "	3·	12·66	24·8	1·79	...	...	62·6	5·66	0·83	4·83	2·47	...	...	0·94	16·71	
19. " "	3·20	12·00	26·7	1·95	...	...	61·3	6·20	0·97	5·23	2·47	...	...	1·04	16·88	
20. " "	3·50	11·09	30·5	1·79	...	...	58·5	6·57	0·97	5·60	2·45	...	...	0·93	14·43	
21. " "	4·	10·36	31·2	2·02	...	...	58·5	5·45	0·89	4·56	2·38	...	...	1·24	22·83	Young leaves without buds.
22. " "	5·	10·72	31·9	2·68	...	11·24	57·4	5·48	0·73	4·75	2·04	...	...	1·27	23·19	
23. " "	7·	11·05	32·8	3·09	5·19	...	57·2	6·83	0·54	5·29	1·99	2·23	38·24	1·56	25·64	

The time is probably not far distant when the tea trade will buy entirely by analysis, supplemented in a few cases by a "taster's" report. An experienced palate will detect particular flavours which analysis may fail to show; but a fairly complete chemical examination of tea is of the highest value, whether as a guide to the purchaser, or merely to show its freedom from adulteration.

(1.) *Preliminary Examination of Tea.*—The tea leaves should be soaked in hot water, carefully unrolled, and their shape and structure examined. Sections can be made of leaves by placing them between two pieces of cork, and cutting fine slices of both the cork and the enclosed leaf; on floating the sections in water, the film of cork may be readily separated from the leaf. The epidermis of the lower upper surface can, with a little practice, be detached in small portions by the aid of a sharp razor, and examined in water, glycerine, or dammar balsam, under the microscope.* The structure of the tea leaf has been already noted. The following is a brief description of the principal leaves supposed to be used as adulterants:—

Beech (*Fagus sylvatica*).—The leaves of the beech are ovate, glabrous, obscurely dentate, ciliate at the edges, the veins running parallel to one another right to the edge. The leaf, slightly magnified, is seen to be divided into quadrilateral spaces by a network of transparent cells. On section, the parenchyma of the leaf is found to consist of an upper layer of longitudinal cells, and a lower of loose cellular tissue, enclosed between the epidermis of the upper and under surface. The whole section is thus divided into oblong spaces by transparent cells connecting the cuticle of the upper and lower surfaces. The epidermis of both the upper and lower surfaces is composed of cells with an extremely sinuous outline. The stomata are small, not numerous, and almost round; average length, ·000996 inch, average breadth, ·00083 inch. Beech leaves contain manganese.

Hawthorn (*Cratægus oxyacantha*).—At least two varieties, the more common of which is the *C. monogyna*, with obovate three to four deeply-lobed leaves, with the lobes acute. The leaf is divided into quadrilateral spaces, like the beech and many other leaves, by a transparent network. The epidermis of the upper surface is composed of a layer of thin-walled cells, generally quadrilateral, outline seldom sinuous. The epidermis of the lower surface has a layer of thin-walled cells, with a very sinuous outline. Stomata large, distinct, and numerous, in many instances nearly round, but the shape mostly oval. The average length of the stomata is ·00166 inch, the average breadth, ·00149 to ·0015 inch.

Camellia sassanqua.—The leaves of *Camellia sassanqua* are oval, obscurely serrate (the younger leaves entire), dark green, glabrous, of somewhat leathery consistence; the lateral veins of the leaf are inconspicuous.

Micro-structure.—The parenchyma of the leaf is placed between two thickened epidermal layers: the epidermis of the upper surface, as seen upon a section, forms a wrinkled, continuous, thick membrane, in which a cellular structure is not very evident. Below this there are two

* There are various section-machines in use, but after trying several I have forsaken all, save in cases of soft, pulpy tissues, &c., where it is convenient to freeze the substance. With a very little practice, sufficient manual dexterity to obtain a fine section is acquired with the fingers alone. The whole of the beautiful preparations whence Schleiden obtained the illustrations for his botanical works were taken by the aid simply of a sharp razor.

or three layers of large cells, more or less oblong, with their long diameter at right angles to the surface of the leaf; and underneath this again is a loose network of cells, resting upon an epidermis in every respect similar to that of the upper surface, but only half as thick. A thin layer of either the upper or lower epidermis shows a peculiar dotted or reticulated appearance, not unlike the rugae of a stomach. The lower epidermis is studded with frequent stomata, which are of an oblong shape; length, ·001328 inch, breadth, ·00083 inch.

Sloe (Prunus communis).—The leaves of the common sloe are rather small, elliptic or ovate-lanceolate in shape, and slightly downy beneath. The sectional thickness of the leaf is the same as that of tea, *viz.*, ·00664 inch. The stomata on the lower surface are scanty; in length about ·00166 inch, in breadth, ·00083 inch. The microscopical appearances are wholly different from those of tea leaves, more especially as seen in section.

Cloranthus inconspicuus.—The leaves of the *chloranthus inconspicuus* are long, oval, serrate, wrinkled, the veins running nearly to the edge, and there forming a network in such a manner, that at the point of intersection little knots are formed, which give the margin of the leaf a very rough feeling. The structure of the leaf is very simple. The epidermis of the upper surface is formed of one or two layers of thin-walled cells, the epidermis of the lower of one or two layers also of cells, and between the two there is a parenchyma of loose cellular tissue. The stomata are oval and rather numerous; their length is from ·001992 to ·002188 inch, their breadth, ·001338 inch. The cells of the epidermis are large, some of them ·005 inch or more in their long diameter.*

The dimensions of the stomata of the various leaves just described may be conveniently arranged in a tabular form, thus—

	Length of Stomata. Inch.	Breadth of Stomata. Inch.
Beech, ...	·000996	·00083
Camellia sassanqua,	·001328	·00083
Tea, from ·001162 to	·001328	from ·000996 to ·001162
Sloe, ...	·00166	·00083
Hawthorn, ...	·00166	·00149
Chloranthus inconspicuus, ...	·001992	·001328

A chemical method for the detection of foreign leaves (adulterants) was first described by the writer in June, 1877.† It is based upon two facts—firstly, that every part of a *theine*-producing plant—wood, stem, leaf, flowers, and even hairs—contains the alkaloid; and, secondly, that this can be readily sublimed. The leaf, or fragment of a leaf, is boiled for a minute in a watch-glass with a very little water, a portion of burnt magnesia equal in bulk is added, and the whole heated to boiling, and rapidly evaporated down to a large-sized drop. This drop is transferred to the "subliming cell," described in another portion of this work (see *Index*), and if no crystalline sublimate be obtained, when heated up to 110°C. (a temperature far above the subliming point of theine), the fragment cannot be that of a tea plant. On the other hand, if a sublimate of theine be obtained, it is not conclusive evidence of the presence of a tea leaf, since other plants of the Camellia tribe contain the alkaloid.

Finally, there is a negative test

* The leaves of *Epilobium angustifolium (common willow herb)* are said to be extensively used in Russia for the adulteration of tea. The dried leaves are sold for from four to six roubles a pound, and are used by the poorer classes in the place of tea. Alcohol produces in infusions of epilobium a precipitate of mucilage.—*Pharm. Zeitsch für Russland Year-Book of Pharmacy.*

† "Micro-Chemistry, as applied to the Identification of Tea Leaves." By A. Wynter Blyth. *Analyst,* June, 1871.

which may occasionally be valuable. All fragments of tea hitherto examined contain manganese, and there are a few foreign leaves in which manganese is constantly absent. Hence, if a leaf be burnt to an ash, and a fragment of the ash be taken up on a soda-bead, to which a little potassic nitrate has been added, the absence of the green manganate of soda would be sufficient evidence that the leaf had not been derived from the tea-plant, while conversely, as in the case of theine, it does not in itself prove it to be tea.

Another portion of the tea leaves should be thoroughly bruised, spread on a glass plate, and carefully searched with a magnet for ferruginous particles—the so-called iron-filings, which are occasionally found, especially in Capers and certain species of Congou. It is almost unnecessary to state that the black, irregular masses found in tea, and attracted by a magnet, are not metallic iron.* Their chemical composition is somewhat variable; they all contain magnetic oxide of iron, and many of them in addition phosphate of iron, titanate of iron, quartz, and mica with a little sand. They are, without doubt, sometimes an adulteration (the author has himself found over 1 per cent.) and sometimes an impurity, for in a few teas, mere traces only of this ferruginous sand may be discovered. Any particles of the kind extracted by the magnet should be collected and treated with hot water, which soon disintegrates them; the adherent tea-dust is separated, and the sand dried and weighed.

To detect facing, the tea in its dried state should be mounted as an opaque object. If it has the appearance of being heavily faced, soaking in warm water will soon detach the film; and indigo, Prussian blue, or similar substances will sink to the bottom, and may be collected and examined. Indigo may be identified by the microscope. Prussian blue may be tested for by warming the deposit with caustic alkali, filtering, acidifying the filtrate with hydrochloric acid, filtering again if necessary, and testing the filtrate with ferric chloride. The residue left after treatment with caustic alkali may be tested for magnesium silicate, by first extracting with HCl, and then collecting the insoluble residue, and fusing it with an alkaline carbonate. The silica is now separated in the usual way by evaporation with HCl to dryness, subsequent solution in weak acid, and filtration; any lime is removed by ammonia and ammonic oxalate; and lastly, magnesia is precipitated as ammon. mag. phosphate. Magnesia found under these circumstances must have been present as steatite or other magnesian silicate.

(2). *Chemical Analysis.*—The preliminary examination of the tea having been concluded, the sample is next submitted to chemical analysis. If the question to be decided is simply that of adulteration, the taste of the infusion, the percentage of extract, and a determination of the chief constituents of the ash is, in most cases, all that is necessary; but a more or less complete examination embraces a quantitative estimation of hygroscopic moisture, theine, total nitrogen, tannin, extract, gum, and ash.

Hygroscopic Moisture.—The ordinary method of taking the hygroscopic moisture of tea is to powder as finely as possible an indeterminate quantity of from 1 to 2 grms., and to heat it in a watch-glass over the

* Mr. Allen appears to have found metallic iron in tea. The test for metallic iron is that nitric acid, 1·2 specific gravity, dissolves it with the production of red fumes; it also precipitates metallic copper, if added to an acidulated solution of cupric sulphate.

water-bath until it ceases to lose weight. It should be finally weighed between two watch-glasses, since it rapidly absorbs moisture from the air.

The method given is in its results incorrect, since some volatile oil and a small proportion of theine are always volatilised. That theine is actually lost is capable of rigid demonstration; it is only necessary to heat a few leaves of tea between two watch-glasses over the water-bath, and theine crystals can be readily discovered by the microscope. To devise a process of drying tea which will represent water only is easy; but since the loss, both of volatile principles and theine, does not materially affect the results, it is scarcely worth while to complicate the analysis by the use either of a lower temperature or of processes of absorption. The highest amounts of moisture in a genuine tea which are on record are two specimens from Cachar, analysed by Professor Hodges—the one (indigenous) gave 16·06 per cent., the other, a hybrid, 16·2 per cent. These were, however, not commercial teas, and appear to have been simply dried in heated rooms. The average hygroscopic moisture found by Mr. Wigner in thirty-five teas, consisting of Hysons, Capers, Souchongs, Gunpowders, and others, was 7·67 per cent., the driest teas being the Hysons and Gunpowders, the moistest the Congous:—

	per cent.
The maximum amount of moisture found in Hyson, ...	5·68
The minimum amount of moisture found in Hyson, ...	4·84
The maximum amount of moisture found in Gunpowder, ...	6 55
The minimum amount of moisture found in Gunpowder, ...	4·94
The maximum amount of moisture found in Congou, ...	1·33
The minimum amount of moisture found in Congou, ...	6·36

The Estimation of Theine or Caffeine.—The modern processes for extracting theine fall chiefly under three heads:—

(1.) *Extraction by treating a decoction of the theine containing substances with lime or burnt magnesia, evaporation to dryness, and subsequent solution of the alkaloid by chloroform, ether, or benzine.*—The fundamental idea of this process perhaps belongs to Müller; it has also, with various modifications, been recommended by Clous, Commaille, Dragendorff, and many other chemists.

Commaille adopts the following method:—5 grms. of finely powdered and carefully sifted substance are made into a hard paste with 1 grm. of calcined magnesia. This, after standing for twenty-four hours, is dried upon a water-bath and powdered. The resulting green powder is exhausted three successive times in a flask with boiling chloroform, the flask being connected with an inverted Liebig's condenser, so that the action may be continued for a long time. The cool solution is filtered, the chloroform recovered by distillation, and the residue in the flask dried. This residue consists of resinous fatty matters and theine; the former are removed by treating the contents of the flask with hot water and 10 grains of powdered glass, which have been previously washed with dilute hydrochloric acid. The water is boiled and the contents shaken up with the glass, the resinous matters attach themselves to the latter in the form of little globules. The solution is poured on a wet filter, and the residue completely exhausted by repeated boiling with fresh quantities of water. On evaporating the united filtrates in a tared capsule, pure caffeine is left in the form of white crystals.

Dragendorff takes 5 grms of the substance, exhausts it with boiling water, evaporates to dryness, adding

2 grms. of burnt magnesia and 5 of ground glass; the finely powdered residue is soaked in 60 cc. of ether for twenty-four hours, and finally thoroughly exhausted by ether. The latter, when separated and evaporated, leaves the theine in a tolerably pure state. He also states that ether may be replaced by chloroform. Cazeneuve and Caillot recommend a very similar process, but magnesia is replaced by recently slaked lime,* ether by chloroform. Markownikoff uses benzine instead of the solvents mentioned.

In all the above processes there is one source of error which does not appear sufficiently guarded against, *viz.* loss of theine during the evaporation to dryness, since it is absolutely impossible to evaporate a decoction of tea and magnesia to dryness at 100°C. without loss of the alkaloid—a loss which, so far as the author's experiments go, does not take place until the mixture is quite dry. The following modification may therefore be proposed:—4 to 5 grms. of the tea are boiled in a flask with an inverted Liebig's condenser for a couple of hours, the liquid and leaves are transferred to an evaporating dish, some magnesia added, and the whole concentrated to a pasty condition. This paste is treated and thoroughly exhausted by chloroform; the latter is separated and evaporated, and the chloroformic extract redissolved in a little boiling water, the solution filtered, evaporated to dryness at a very gentle heat, and weighed.

(2.) *Simple treatment of the powdered leaves by solvents.*—Legrif and Petit soften the leaves first with boiling water, and then extract the moist mass by the aid of chloroform. Other chemists simply exhaust the powdered substance by chloroform or ether; subsequent purification may of course be necessary.

(3.) *Sublimation.*—A method of utilising tea dust by making it a source of theine, was recommended by Heijnsius (*Journ. Prac. Chem.*, xlix., 317). The tea dust was simply treated in a Mohr's benzoic acid subliming apparatus. Stenhouse improved this process by precipitating either a spirituous extract, or a decoction of tea by acetate of lead, evaporating the filtrate to dryness, mixing the residue with sand, and subliming. These processes of sublimation, however, were proposed simply for the extraction, not the estimation of theine.

The writer in 1877* proposed the following quantitative method of sublimation:—A convenient quantity of the tea was boiled in the way mentioned, magnesia added, and the whole evaporated to a paste, which was spread on a thin iron plate, and covered with a tared glass funnel. The heat at first was very gentle, but was ultimately raised at the later stages of the process to 200°C. The theine sublimes perfectly pure and anhydrous, and forms a coherent white coating on the sides of the funnel; the increase of weight is simply anhydrous theine. To ensure success it is absolutely necessary—

(1) That the layer be as thin as possible.

(2) That the heat be only gradually increased.

(3) That the mixture be occasionally cooled, and then thoroughly stirred.

(4) That the sublimation be prolonged for a sufficient time.

The sublimation is finished when a funnel, inverted over the substance, heated to about 150°C., and left for half an hour, shows no crystals.

* The present writer does not believe that magnesia can be replaced with lime without loss of theine from decomposition.

*Op. cit.

Determination of Total Nitrogen.—Peligot, and Wanklyn as well, have laid particular stress on the large amount of nitrogen contained in tea leaves. This nitrogen is, of course, largely dependent on the theine, and it is questionable whether, with the improved methods for the extraction of the latter, it is worth while to make a combustion, more especially as the exhausted leaves are highly nitrogenous, from the presence of an albuminous body. The process is conducted in the usual way in a combustion tube, and best with copper oxide. The following are a few determinations of total nitrogen:—

	Per cent.	Analysed by
A sample of genuine tea from Cachar, ...	4·74	Hodges.
A hybrid variety, do. ...	2·81	"
Another sample from Cachar, ...	4 42	"
Sample taken from 60 green teas slightly faced,	3·76	"
60 Black teas, ...	3 26	Wigner.
6 Assam teas, ...	3 64	"
6 Caper teas, ...	3·32	"
Assam tea, from Dr. M'Namara's garden. ...	3·88	"
Sample of exhausted leaves,	3·80	"

Mr. Wanklyn has applied his ammonia process to the examination of tea. The soluble matter from 100 mgrms. of tea is heated with a 10 per cent. solution of potash in a flask fitted to a proper condenser, until all the ammonia is distilled over. It may be necessary to add water once or twice, and redistill; then 50 cc. of a strong alkaline solution of permanganate of potash are added and distilled; the ammonia in the distillates is estimated by "Nesslerising." Mr. Wanklyn gives the following figures as yielded by a genuine tea:—

	Mgrms.
Free Ammonia, ...	0·28
Albuminoid Ammonia,...	0·43
	0·71

100 mgrms. of genuine tea, sent to the writer by Dr. Shortt, of Madras, yielded total ammonia ·81. We only require a few hundred determinations of ammonia in this way, to have some guide to the variations met with in all kinds of tea; this would afford far more information than an ordinary combustion.

Determination of Tannin.—The methods proposed for the determination of tannin are very numerous. Three only, however, require any notice here—*viz.*, the gelatine process, Mr. Allen's acetate of lead process, and Löwenthal's process.

(1.) *By Gelatine.*—The best process by gelatine is decidedly that which dispenses with the drying and weighing of the precipitate. A solution of gelatine is carefully made by first soaking the gelatine in cold water for twelve hours, then raising the heat to 100° C., by placing the bottle on the water-bath (the strength should be about 3 per cent.), and finally about ·8 per cent. of alum should be added. A portion of the solution thus prepared is put into an alkalimeter flask (*e.g.*, Schuster's), and carefully weighed. A solution containing a known quantity of tannin is now titrated with the gelatine until a precipitate no longer occurs: the flask is reweighed, and the loss shows approximately the strength of the solution. One or two more exact determinations will be required to get the correct value. It is necessary to allow the precipitate now and then to settle, and a few drops of the supernatant fluid should be placed on a watch-glass, to which a drop of gelatine may be added, and thus the point of saturation ascertained. The tannin in a decoction of tea is, of course, estimated on precisely similar principles.

(2.) *Mr. Allen's Lead Process.*—A filtered solution of lead acetate 5 per cent., a solution of 5 mgrms. of pot. ferridcyanide, 5 cc. of strong ammonia water, and 5 cc. of pure water, and lastly, solution of pure

tannin (·1 per cent.) are required. The process essentially depends upon the precipitation of tannin by lead acetate, and using ammoniacal pot. ferridcyanide as an indicator. The latter agent strikes a pink colour with tannin. The solution is standarised by taking a known volume of the lead solution, and dropping in the tannin liquid until a small portion filtered gives a pink colour with the indicator.

Tea is tested in a precisely similar manner. Mr. Allen's method is tolerably speedy and accurate; the writer has, however, found the final reaction somewhat difficult to observe.

(3.) *Löwenthal's process.*—Up to the present time this method (originally worked out for barks) is the best we possess; it depends on the oxidation by permanganate, and indigo is used as an indicator. It not alone gives us the tannin, but the amount of other astringent matters as well. The following solutions are required:—

(1.) A solution of potass. permanganate, 1·333 grms. per litre.

(2.) Precipitated indigo, 5 grms. per litre.

(3.) Dilute sulphuric acid (1 : 3).

(4.) A solution of gelatine, 25 grms. to litre, saturated with table-salt.*

(5.) A saturated solution of pure salt, containing 25 cc. of sulphuric, or 50 cc. of hydrochloric acid per litre.

The analysis, as applied to the determination of tannin in barks, is performed thus:—10 grms., say, of sumach are taken and exhausted by boiling with water, and the solution made up to 1 litre; of this infusion 10 cc. are mixed with 75 cc. of water, 25 cc. of the indigo solution added, and 10 cc. of the dilute sulphuric acid. The permanganate solution is run drop by drop from the burette with constant stirring, till the blue color changes to yellow, when the amount of permanganate used is noted (x). The same process is repeated with indigo and sulphuric acid, and the amount read off (y); subtracting y from x= total astringent matters. The permanganate oxidises both tannin and indigo, but the tannin being the easier to oxidise is consumed first. In order to obtain accurate results, the proportion of indigo should be such as to require about twice the quantity of permanganate which would be consumed by the tannin alone. Thus, if indigo alone requires 10 cc. of permanganate to decolorise it, the indigo and tannin together must not take more than about 15 cc.; if it does so, the tannin must be diluted accordingly. The total astringent matters being known, the next step is to throw the tannin out, and estimate the gallic acid and impurities. 100 cc. of the infusion are mixed with 50 cc. of the salted gelatine infusion; after stirring, 100 cc. of the salt acid solution are added, and the mixture allowed to stand for twelve hours. It is then filtered, and an aliquot part of the filtrate is oxidised by permanganate and indigo, as before.

Löwenthal gives the following example: 10 grms. of sumach were boiled in 750 cc., and after cooling made up to one litre:—

			Permanganate.
(1.)	10 cc. of sumach infusion, ... cc. of indigo solution, ...	consumed,	16 6
	Ditto,	repeated,	16·5
			33·1
	50 cc. of indigo solution alone,		13·2
	Total permanganate for 20 cc. of sumach, ...	...	19·9

* Löwenthal prepares the solution by steeping 25 grms. of the finest Cologne glue in cold water over night; it is then melted on the water-bath, saturated with NaCl, and made up to 1 litre with saturated NaCl solution, filtered, and kept well corked.

(2.)	50 cc. filtrate from the gelatine, ... 25 cc. indigo solution, ...	consumed,	11·2
	Ditto, ...	repeated,	11·1
			22·3
	50 cc. indigo alone,		13·2
	Gallic acid and impurities, ...		9·1

Deducting 9·1 cc. from 19·9 cc. equals 10·8 cc. as permanganate, equivalent to the tannin of 20 cc. of sumach infusion, or 0·2 grms. of dry sumach. It is well to ascertain the value of the permanganate solution by oxalic acid, adopting the numbers given by Neubauer and Oser—*viz.*, that 0·063 oxalic acid is equal to 0·04157 gallo-tannic, and ·062355 quercitannic acids. Should it be preferred to use tannin, the purest commercial tannin must be precipitated by lead, the precipitate freed from lead in the usual way, and the solution of pure tannin then evaporated to complete dryness, and a solution of convenient strength made. The process requires but little modification to be applicable to tea.

The amount of tannin in genuine teas seems to be variable, the lowest number being apparently about 8 per cent., whilst Mr. Wigner, as example of very astringent teas, gives the following:—

	Per cent.
Moyone Young Hyson,	39·0
Very choice Assam,	33·0
Indian Young Hyson,	39·0
Assam tea from Dr. M'Namara's garden, ...	27·7
Caper, mixed,	42·3

Exhausted tea leaves yield from 2 to 4 per cent. of tannin. A tea giving only 6 or 7 per cent. of tannin is to be regarded as suspicious, but care must be taken not to rely upon any single indication.

The Extract.—The extract is a measure of the soluble matter in tea. Peligot exhausted the leaves and then redried them, and thus estimated the soluble matter by difference. Wanklyn, however, has proposed a more rapid and convenient method. It consists in taking 10 grms. of tea, and boiling with 500 cc. of water, the flask being adapted to a Liebig's condenser. When 50 cc. are distilled over, the process is stopped, and the 50 cc. returned to the flask; 50·3 grms. of the hot strained liquid are then weighed out and evaporated to dryness. Wigner boils with a vertical condenser for an hour, and finds that 1 per cent. strength yields the most constant results. Perhaps, on the whole, the best process is the following:—Place one part of tea in 100 of water, boil for one hour with a vertical condenser, and then take an aliquot part of the filtered liquid for evaporation. In every case the time occupied in boiling, and the strength, should be mentioned in reporting, for two analysts operating by different methods may differ as much as 6 or 8 per cent.—the soluble matter not being entirely removed for a very long time. Since the substances that are at once dissolved are really those upon which its commercial value depends, it is a question whether it would not be better simply to pour boiling water on the leaves, let the infusion stand for one hour, and then estimate the extract, calling it *extract of infusion.*

Any addition of exhausted leaves lowers the percentage of extract. The following are some determinations of extract:—

	Per cent.	Analysed by
Java tea, dried, ...	35·2	Peligot.
" not dried, ...	32·7	
Pekoe, ordinary, dry, ...	41·5	
" " undried,	38·0	
Gunpowder, dry, ...	51·9	
" undried, ...	48·5	
" dry, ...	46·9	
" undried, ...	50·2	
Moyone Gunpowder, ...	40·7	Wi
	39·3	
	38·5	
	37·9	
	33·3	

	Per cent.	Analysed by
Imperial, dry, ...	43·1	Peligot.
,, not dried, ...	39·6	,,
,, dry, ...	47·9	,,
,, not dried, ...	44·0	,,
Hyson, dry, ...	47·7	,,
,, not dried, ...	43·8	,,
,, skin, dry, ...	43·5	,,
,, not dried, ...	39·8	,,
Congou, ...	36·8	,,
,, dried, ...	40·9	,,
,, bon, ...	40·7	,,
,, ,, dried, ...	45·0	,,
,, ...	33·0	Wigner.
,, ...	29·8	,,
,, ...	29·8	,,
,, ...	26·2	,,
,, ...	26·1	,,
Caper, dried, ...	39·3	Peligot.
,, not dried, ...	35·8	,,
,, ...	37·9	Wigner.
,, ...	37·7	,,
,, ...	32·4	,,
,, ...	30·0	,,
Assam, dried, ...	45·4	Peligot.
,, not dried, ...	41·7	,,
,, ...	33·3	Wigner.
Hyson, ...	36·8	,,
Moyone Young Hyson, ...	44·8	,,
Tea direct from China, dry, ...	41·7	Wanklyn.
Tea direct from China, dry, ...	40·2	,,
Tea direct from China, dry, ...	41·2	,,
Indian tea, dry, ...	33·9	A. Wynter Blyth.
,, ...	43·8	Wigner.
Broken Indian, ...	43·4	,,
Indian Souchong, ...	32·5	,,
Scented Orange Pekoe, ...	34·2	,,
Mauuna, fine. ...	37·0	,,
Himalayan tea, ...	38·6	Wanklyn.
,, ...	35·4	,,

Since the extract of genuine tea appears to vary from 26 per cent. up to more than 40 per cent., it is unfortunately of no very great value for purposes of estimation. The extract, after being weighed, is burnt up to an ash, which will always be found to be heavy, rich in alkaline salts, and varying usually from 4 to 7 per cent.

The Ash.—The percentage of total ash is taken by burning up 1 to 5 grms. of the tea in a platinum dish. The leaves readily ignite, and the operation may take place at a very low temperature, so that there is, with care, very little volatilisation of chlorides. The comparative composition of the ash of fresh and of exhausted tea leaves is shown in the following table:—

	Zoller.	Hodges.		Zoller.	Wigner.	
	Ash of fine young Himalaya Tea.	Tea from Cachar (indigenous.)	Tea from Cachar (hybrid.)	Exhausted Tea Leaves.	Ash of a number of mixed Black Teas.	Ash of a number of mixed Green Teas.
Potash, ...	39·22	35·200	37·010	7·34	30·92	28·42
Soda, ...	0·65	4·325	14·435	0·59	1·88	2·08
Magnesia, ...	6·47	4·396	5·910	11·45	......	......
Lime, ...	4·24	8·956	5·533	10·76	......	......
Oxide of Iron, ...	4·38	2·493	2·463	9·63	......	......
Manganous Oxide, ...	1·03	1·024	0·840	1·97	......	......
Phosphoric Acid, ...	14·55	19·030	9·130	25·41	......	......
Sulphuric Acid, ...	trace.	5·040	6·322	trace.	4·88	5·68
Chlorine, ...	0·81	3·513	2·620	trace	......	......
Silica and Sand, ...	4·35	0·50	1·300	7·57	1·70	7·50
Charcoal, ...	......	2·900	1·930	......	......	......
Carbonic Acid, ...	24·30	13·590	12·600	25·28	11·60	6·43
	100·00	100·00	100·00	100·00	......	......
Percentage of total Ash soluble in water, ...	......	......	......	......	57·00	52·85

The ash on being cooled and weighed, is next boiled up with a little water, the soluble portion filtered from the insoluble, and washed in the ordinary way. The filtrate is evaporated to dryness, very gently ignited, and returned in percentage as soluble ash. The insoluble portion is next treated with acid, and the remaining sand dried, ignited, and weighed. The alkalinity of the soluble portion should also be taken, and may be returned as potash. This simple examination of the ash, consuming very little time, gives, tolerably well all the information afforded by a complete and exhaustive analysis. The following table shows a few

percentages of ash and may be compared with the percentages of beech, bramble, &c. :—

	Total Ash. Per cent.	Ash soluble in Water. Per cent.	Ash soluble in Acid. Per cent.	Silica.	Potash.	Authority.
Average of 17 ordinary teas from original chest, consisting of 2 Indian, 12 Congous, 2 Gunpowders, and 1 Hyson, ...	5·75	3·07	2·25	0·43	1·33	G. W. Wigner.
Maximum, ...	6·03	3·35	2·87	0·76	1·83	,,
Minimum, ...	5·53	2·75	1·99	0·15	1·17	,,
Average of 25 special teas,	5·95	3·33	2·09	0·53	1·83	,,
Maximum, ...	7·02	3·88	2·63	1·67	1·96	,,
Minimum, ...	5·17	2·64	1·33	0·04	1·08	,,
Genuine Indian tea, ...	5·61	2·90	......	......	......	A. Wynter Blyth.
Common tea, ...	5·92	3·55	......	......	......	Wanklyn.
Paraguay tea, ...	6·28	4·22	......	......	......	,,

	Total Ash. Per cent.	Ash soluble in Water. Per cent.	Ash soluble in Acid. Per cent.	Silica.	Potash.	Authority.
Average of 7 teas, ...	5·75	......	......	......	......	A. S. Wilson.
Average of 9 teas, ...	5·66	3·00	......	......	......	A. H. Allen.
Horneman's p. black, ...	5·30	3·50	......	......	......	,,
Horneman's p. green, ...	5·60	3·80	......	......	......	,,
Ambrosial black, ...	5·60	3·40	......	......	......	,,
Genuine blk., 2*s*. 6*d*. lb ...	5·60	3·09	......	......	......	,,
Genuine blk., 2*s*. 6*d*. lb. ...	5·70	3·28	......	......	......	,,
Genuine blk., 2*s*. 6*d*. lb. ...	6·02	3·26	......	......	......	,,
Genuine blk., 2*s* 6*d*. lb....	6·34	3·20	......	......	......	,,
Genuine blk., 2*s*. 6*d*. lb....	6·10	3·96	......	......	......	,,

	Total Ash. Per cent.	Ash soluble in Water. Per cent.	Ash soluble in Acid. Per cent.	Silica.	Potash.	Authority.
Genuine blk., 2*s*. 6*d*. lb. ...	5·75	3·06	......	......	......	A. H. Allen.
Genuine blk., 3*s*. lb. ..	5·50	3·55	......	......	......	,,
Broken leaf with stalks.,	5·40	2·80	......	......	......	,,
Caper (4·8 silica), ...	11·40	1·50	......	......	......	,,
Mixed, dry exhausted leaves from various teas, ...	4·30	0·52	......	......	......	,,
Coffee leaves,	10·32	3·77	......	......	......	,,
Beech, ...	4·52	2·00	......	......	......	Wanklyn.
Bramble, ...	4·53	1·84	......	......	......	,,
Raspberry, ..	7·84	1·72	......	......	......	,,
Hawthorn, ...	8·05	3·78	......	......	......	,,
Willow, ...	9·34	4·16	......	......	......	,,
Plum, ...	9·90	5·66	......	......	......	,,
Elder, ...	10·67	3·19	......	......	......	,,
Gooseberry, ..	13·50	7·83	......	......	......	,,

All the analyses hitherto published show that the percentage of ash in genuine tea never reaches 8 per cent. An ash beyond 8 per cent., calculated on the dried tea, is certainly adulterated. In the same manner, all genuine tea possesses soluble ash not less than 3 per cent. For examples of obviously impure ashes, Mr. Wigner's paper may be quoted from again :—

	Total Ash.	Ash soluble in Water.	Soluble in Acid.	Silica.	Alkali. calculated as Potash.	Extract.
wder,	19·73	1·00	6·15	12·58	0·14	37·78
per, ...	14·44	1·95	2·47	10·02	1·03	35·45
,, ...	15·20	1·69	5·35	8·16	0·61	31·60
,, ...	15·08	1·96	5·65	7·47	0·73	35·60
,, ...	12·74	2·68	5·44	6·62	1·04	......
,, ...	14·60	2·67	5·67	6·06	1·04	......

All these teas, although imported in this state, are evidently mixed with sand to a considerable extent.

Determination of Gum.—If it is necessary to determine the gum in tea, as sometimes happens, the aqueous decoction should be evaporated nearly to an extract, and the residue treated with methylated spirit, filtered, and washed with the spirit The gum is dissolved off the filter by the aid of hot water, and the solution evaporated to dryness, and weighed; it is then ignited to an ash, and the mineral deducted from the total weight.

General Review of the Adulterations of Tea.—The most frequent are certainly the addition of sand, generally strongly impregnated with iron, the addition of foreign and exhausted leaves, and the addition of astringent principles, such as catechu, &c. All these adulterations must take place abroad, there being no evidence that a single hundredweight of tea has been tampered with in England,—the blame *may* lie with the home-traders, but proof is wanting. On the other hand, it not unfrequently happens that cargoes of tea recovered from sunk vessels, or teas damaged in some other way, are sold and blended by wholesale manufacturers with those that are genuine. Such samples contain usually an excess of salt, and show more or less evidence of the addition of exhausted leaves.

The facing of tea is rapidly decreasing. There has been much dispute as to whether this is to be considered an adulteration or not; a thin film of graphite, or any other harmless substance, in such quantity as to add no appreciable weight, can hardly be called adulteration. Each case, however, must be judged of by its merits. A small addition of such a substance as catechu, to impart astringency, is probably frequent, and difficult of detection. Any amount present, to the extent of 3 per cent. or over, is shown by precipitating an infusion of the tea with a slight excess of neutral lead acetate, filtering, and adding a little dilute ferric chloride solution. If catechu be present there is a bright-green colour, and ultimately a precipitate of a greyish-green colour. The same infusion filtered from the lead precipitate gives a copious precipitate with argentic nitrate. Mr. Allen has pointed out the advantage of his lead process in cases of adulteration with catechu, and it is self-evident; for catechuic acids possess a precipitating power so widely different from that of tannin, that, if reckoned as tannin, there are always anomalous results, indicating a much higher astringency than could possibly exist,—*e.g.*, a sample of brown catechu examined in this way, and reckoned as tannin, gives the paradoxical number of 11 per cent.

Soluble iron salts, alkaline carbonates, and other substances, are stated to be occasionally added, but no conviction relative to these appears to be on record. The soluble iron salts may, of course, be dissolved from the tea leaves by a little cold dilute acetic acid, and the liquid tested in the usual way; there is then no confusion between the iron naturally present and that added.

Adulteration of Chinese Green Teas.

When, as has been frequently the case, we have referred to the adulteration of China teas, we have been met by many in the London trade with denial, as it was their interest to bolster up that of which they could make the most money. Even the public analyses occasionally made failed to convince the "trade." We now learn that a French chemist has discovered, not only plumbago in Chinese green teas, but Prussian blue and Kalin (finest Chinese clay).

Tea Leaves.

By A. Wynter Blyth, F.C.S.

I have been lately examining tea leaves, with a view of obtaining some chemical test, either peculiar to them or, at all events, restricted to the "Theine" producing plants. The result of my experiments has been the establishment of a process of great simplicity which will enable anyone in a few minutes to pronounce whether the merest fragment of a plant belongs to the "Theine" class or not. The procedure is based upon the well-ascertained fact that, the alkaloid, already alluded to, is distributed in the woody tissue, the bark, the stem, the leaf, the flower, in short, in all parts of a "Theine" plant, and this is the more especially true in the case of the various species of Thea. Now this "Theine" has some very characteristic properties; the most useful of these for my present purpose are that it commences to sublime at the comparatively low temperature of 101°C.; that it sublimes from organic substances in a perfect pure crystalline state; that the crystals have a very definite, easily recognisable form, and that a $\frac{1}{1000}$ of a milligramme is distinctly seen, and may be identified by the aid of the microscope. The details of the process I use are as follows:—

(1.) The leaf or fragment, if it is desired to examine it subsequently by the microscope, is boiled in a very small quantity of water, say a cubic centimetre, and the little decoction is transferred to a watch glass, a minute quantity of calcined magnesia added and the whole evaporated nearly to dryness on the water bath; the extract is next transferred to the surface of a thin circular disc of microscopic covering glass, which is covered with a second circular disc of thin glass, the whole forming what I will call "the subliming cell"—the subliming cell is placed on the surface of an iron plate which carries a cup of mercury in which is inserted a thermometer, and the plate is fitted in the ordinary way to a retort stand. This method of sublimation, in all its essential features, is identical with the one proposed and employed years ago by Dr. Guy. On heating the iron plate, first moisture is given off and condenses on the cover of the subliming cell, and this cover may be removed and replaced by a second. In a very short time after it has become dry, a light mist is seen on the upper disc, and this mist the microscope resolves into beautifully distinct crystals of theine—they may be identified as "theine" by re-subliming when it will be found they will rise to the upper disc as about the temperature of 101°C. The subliming temperature of the extract itself is rather variable; the extract should be heated, if no mist or crystals become visible, up to as high as 220°C, and, if still no crystals are obtained, the substance most certainly contains no "theine." In all my experiments I have always obtained a sublimate from genuine products derived from tea or coffee below 200°C.

(2.) The substance is boiled and treated with magnesia as before, the solution cooled, a bit of dialysing parchment folded and cut into a miniature filter form, and placed in a glass tube, which, as very small quantities are being dealt with, need be no bigger than a thimble, or a porcelain crucible may be used, which, being always at hand, will perhaps be more convenient than anything else. The solution is then, by this little dialysing apparatus which I need not further detail, dialysed for twelve hours, a yellow colouring matter and theine are found in the outer liquid; a microscopic examination of this liquid, when evaporated down, will readily discover crystals of theine. As in the former case, the fragments of the leaf itself is uninjured, and can be put to any supplementary examination desired.

(3.) The leaf is boiled for a minute or two in a watch glass with a little water, a portion of magnesia equal in bulk is added, and the whole heated to boiling and thus rapidly evaporated down to a good-size drop, this drop containing yellow colouring matter; magnesia and theine is poured on to one of the thin discs of glass already mentioned, and then evaporated nearly to dryness on the subliming plate. When it approaches dryness the "subliming cell" is completed by the circle of glass and cover, and in this way a sublimate is readily obtained. If the substance is derived from a theine-producing plant, a distinct sublimate of theine will be the result. The leaves, etc, of the tea plant also yield, without any preparation whatever, scanty sublimates of theine, and coffee gives up a very large proportion of alkaloid, below 110°C., but at all events in the case of tea it is most certain to operate with magnesia as described. I may here remark, that if a small quantity, say a gramme, of finely-powdered tea be placed between two watch glasses and heated in the water bath in the usual way, on removing the upper glass, at the end of an hour or so, all round, but

within, the edge, crystals of "theine" canbe discovered by the microscope. It is then evident that in the ordinary way of taking the hygroscopic moisture of tea there is some loss of theine, but this is, I think, too small to be regarded in mere technical processes. I should also add that the addition of magnesia to a decoction of tea or coffee for the purpose of dialysis is not absolutely essential, since theine (somewhat scantily) dialyses without the addition of any re-agent. The main objection to the processes I have given is their extreme delicacy; any speck of a tea leaf, which is easily visible to the naked eye, will yield its infinitesimal group of crystals to the cover of the subliming cell, hence, in the examination of a foreign leaf, any fragment of genuine tea mechanically adhering to it may give rise to error. It must, however, be borne in mind that a great many leaves in the vegetable kingdom will yield, by appropriate treatment, micro-chemical evidence as definite as that of tea, and the time may come when a large proportion of minute vegetable products will be identified, not alone by the shape of their stomata, their epidermal appendages, or the structure of their ultimate vesicles, but by isolating their acids, their glucosides, or their alkaloids, and evolving a microscopical *corpus delicti* from a milligramme of crude material.

Quantitive Determination of Theine.—Struck with the ease and purity with which theine sublimed, it was but natural that I should attempt to work out a quantitive method of sublimation. I believe I have been successful, and, according to my own repeated experiments, the process I give here is both quick and accurate.

A quantity, not less than one gramme, or more than two grammes of either tea or coffee in its undried state, is as finely powdered as possible, and treated in a flask of 70 c. c. of water; the flask is attached to a reversed Liebig's condenser, and the liquid boiled for one hour, the decoction, including the powdered substance, is transferred to a porcelain dish, about the same weight of calcined magnesia, as the substance originally taken is added, and the whole evaporated down to nearly dryness; the powdery extract is now transferred to the iron subliming plate already spoken of and covered with a tared glass funnel, the edge of which must be accurately ground, and the tube of which must be several inches long. The substance should form a very thin equal layer within the circle of the funnel, which may be easily accomplished by a series of gentle taps. The heat at first should not exceed 110°C., then, when the substance appears thoroughly dry, it may be gradually raised to 200°C, and towards the latter stages up to 220°C. If the heating has been properly regulated, there will be no distillation of empyreumatic products, but the alkaloid sublimes, in the cool part of the funnel, in a compact coating, cone-shaped, of beautifully white silky crystals. In order to ascertain when the sublimation is complete, the tared funnel may be cooled and weighed at intervals, or a series of tared funnels may be kept on hand, and changed until no more theine is extracted. The funnel, as well as the theine, as may be expected, at the end of the process is perfectly dry, and the increase of weight is theine, pure and simple. By the method described I have made numerous determinations of theine, and have afterwards digested the powder remaining for 24 hours in ether, but have failed to obtain any crystalline product. I therefore believe that the whole of the alkaloid is sublimed, and that the results, with care, are accurate. From one or two grammes may be considered by some too small a quantity for an accurate assay; and if so, there is no reason why very much larger weight should not be used; indeed, the process is well adapted for working on a large scale, and, if there ever should be any great demand for the alkaloid, would probably be employed. There is yet another micro-chemical test which belongs to pyrology; and that is the presence of manganese in the ash of tea. The ash of a single leaf will give a distinct green manganate of soda bead, and unfortunately for our purposes, so will the ash of a great many other leaves; but since I have never found any tea leaf without manganese, if it should happen that a leaf in tea would not respond to this test, I should consider it conclusive evidence of a foreign leaf.

The Use of Leaves.

If roots are important as the plant mouths, leaves are no less so as the lungs and digestive organs. The vigor of the flower and seed, the success of the cutting, or of moving, all are connected with what the leaves have done or are doing.

Fluid gathered from the ground and gases from the air are changed inside the leaf into the living food of the plant, and the disasters from cutting kitchen garden crops till they are weakened past use, clearing away leaves in the flower garden whilst yet green, and the miserable condition of drawing-room plants, are often just so many examples of what comes of cutting off food, or the power of forming it.

Take a leaf and tear it. It is made of thin skin outside, green granular substance inside, with fibrous veins usually in a net-work. Under the microscope these parts all show as made up of separate bladders or cells, as in the figure of a piece of the leaf of Sweet William magnified; those of the skin flat and colourless, with occasional small openings amongst them (A); those of the green granular mass roundish and loosely packed together (B); whilst the spindle-shaped and long cells or vessels forming the tough fibres of the veins (C); and leaf-stem give support to the leaf, and connection with the bark and inner part of the stem.

Here is the living machinery; fluid with the plant food in solution flows to it from the root; gas is imbibed through the thin outer coat from the air, and, under the influence of sunlight, colouring matter is formed in the green cells, and starch and the various matters that build up the plant structures are formed or deposited, whilst the spare moisture from the fluid constantly bringing in the supplies from the root is given up by evaporation through the skin.—*Gardener's Chronicle.*

The Properties of Tea.

A POUND of the best tea, according to an analysis recently made, contains the following ingredients:—

	Ounces.	Grains.
Water	0	350
Theine	0	210
Caseine	2	175
Aromatic oil	0	52
Gum	2	385
Sugar	0	211
Fat	0	280
Tannic acid	4	87
Woody fibre	3	87
Mineral matter ...	0	350

In answer to the question whether theine produces wakefulness, we answer from the best authorities, No.

The effect of theine upon the system is a calming one, producing a sense of repose.

We stated in a former article that theine supplied to the system that which was lost to it by fatigue. In looking up the authorities we find that there is a substance in the flesh or muscles of animals which is called kreatinine, the chemical properties of which are very similar to those of theine. An analysis of the two show that they contain:—

	Carbon.	Nitrogen.	Hydrogen.	Oxygen.
Theine ...	8	2	5	2
Kreatinine	8	3	7	2

It is claimed "that those substances are most agreeable to the system as food, which most nearly resemble the compounds that form the tissues of the body, while those act as poisons whose compositions are most different from that of the tissues, on which the life of the body depends."

Those who have made the matter a study inform us that the substance in the muscles known as kreatinine is diminished by fatigue.

As theine and kreatinine are chemically about one and the same thing, the theory is acceptable that the theine in tea supplies that which is lost to the system through fatigue.

The property which is called caffeine in coffee is the same as theine.

It is also found that theine and quinine are similar. By analysis these substances are shown to contain the same proportions of carbon, nitrogen, hydrogen, and oxygen, and as it is well known that quinine is about the only remedy for intermittent fevers and ague, one can readily understand why it is that tea is so soothing and beneficial to one who is feverish, tired, and debilitated, and while we cannot say that tea will cure fever and ague, we certainly believe it acts as a preventative.

The question is often asked,—Will tea make one nervous? One or two cups of tea made moderately strong will not make any one nervous, but if taken in excess, it will. Tea experts who are tasting all day for the purpose of testing teas, are made exceedingly nervous.

Tea, like liquors and drugs, when taken in a moderate quantity, will produce one effect, but if taken in a large quantity, will produce just the contrary effect.

The most important component parts of tea are theine, the volatile oil, and tannic acids.

The volatile oil gives to tea its flavour. We have not been able to find any chemical analysis of this oil. The effect it has upon the system is to produce wakefulness. It is stated by those who have made these subjects a special study that this volatile oil acts upon the system in the same manner that digitalis—foxglove—does.

"When foxglove is given there is great anxiety with palpitation of the heart, and unless given in poisonous doses, inability to sleep." It is a well-known fact that Green tea will produce these effects upon some persons, when Black teas will not.

In a former article we explained the difference between Green and Black tea. The fermentation that the Black tea goes through destroys to a great extent this volatile oil, or rather we should say, changes its character, not only in its effect upon the system, but in the flavour it produces in the tea. We say that a Green tea has a fine flavour, also that a Congou has a fine flavour, but they are totally unlike.

The flavour in tea is produced by this volatile oil.

We know of no better illustration of the effect that fermentation has upon plants than that of tobacco. A tobacco that is poorly cured, *i.e.*, not sweated enough, will, when smoked in a pipe, bite the tongue, and will produce dizziness, but when well cured it has a smooth, rich, oily flavour. The volatile oil is still there, but its character is changed.

About one-fourth of the chemical properties of tea is tannic acid or tannin.

Tannin is a powerful astringent; it is this that puckers up the mouth when one is chewing the tea. As to whether tannin assists digestion or not is a mooted question. The old saying that "what's one man's meat is another's poison," will apply to this question. Some persons find that when eating or after eating, if they drink tea it has a soothing effect, but if they drink coffee instead of tea they get nervous and their food does not digest. As there is no tannin in coffee, it stands to reason that tannin must have some influence upon the digestive organs.

Tea should be drunk while eating, or soon after a meal.

Some authorities claim that there is nourishment in tea; others say that there is not, but that tea consumes food; others affirm that it assists digestion. But anyone who has been troubled with dyspepsia and has consulted several physicians knows that digestion is a subject upon which "doctors will disagree."

This we know by experience, that tasting tea upon an empty stomach is injurious, producing a sense of weakness in the stomach the same as though one had fasted a long time.

In making tea, a sufficient quantity should be made at the first drawing. The custom of filling the teapot the second time is not right, as the theine, which is easily soluble in hot water, will be in the first drawing, but will not be in the second, and those supplied from the second drawing will not get the most beneficial part of the tea, but will have a decoction composed chiefly of tannin.

Tea should not be boiled, as the volatile oil will escape with the steam, and a much larger proportion of the tannic acid is extracted, making the effusion bitter.

The best way to make tea is to have an earthenware tea-pot, which should be placed over the fire until it is hot; then put the dry tea in the pot. After being allowed to stand for a few minutes pour in the boiling water. The water should be freshly boiled, and should be allowed to boil full two minutes before it is poured upon the tea. After drawing from seven to ten minutes in the tea-pot it is at the best point for drinking.

ANALYSIS OF TEA ASH.

THE quantity of ash in air-dried tea is about 5·63.*

An analysis of the ash of Himalayan tea by Zoller gives the following composition :—

Potash	39·22
Soda	·65
Magnesia	6·47
Lime	4·24
Oxide of iron	4·38
Protoxide of manganese ...	1·03
Phosphoric acid	14·55
Sulphuric acid	...
Chlorine	·81
Silica	4·35
Carbonic acid	24·30
	100·00

This analysis is especially important, inasmuch as the tea which furnished the ash was of guaranteed purity. The peculiarity of the ash of tea, and where it differs from that of coffee or cocoa, is in its containing about 1 per cent. manganese.—*Ceylon Observer.*

NAMES OF DIFFERENT SORTS OF TEA.

THE MEANING OF THE WORDS PEKOE, SOUCHONG, CONGOU, &c.

Pekoe.—Is from the Chinese Pai-hao, white down or hair, because made from young spring leaf-buds while there is still down upon them.

Souchong.—Is from Seao-chung—Little sprouts.

Congou.—Is a corruption of Kung-fou—Labour.

Hyson.—He-Chun—fair spring.

Young Hyson.—Yu-chien—before the rains.

* An appreciably larger percentage of ash would indicate inferior tea.

TEA SUBSTITUTES.

YERBA MATE, OR PARAGUAY TEA.

Yerba Maté is a product which, although it does not enter into European commerce, deserves notice from its extensive consumption in many of the South American States. In the former edition of the work full details were given of the mode of collecting and preparing the leaves, &c., and it is therefore only necessary now to give a more abridged description. The Yerba Mate is obtained from some species of holly, which have been well described by Mr. J. Miers in a paper on the history of the Maté plant, in the 'Transactions of the Linnean Society.' * He shows that besides the *Ilex Paraguariensis*, St. Hil., there are several other species and varieties employed. Dr. H. Demessey also published a good account of it in his 'History, Physical, Economic, and Political, of Paraguay,' two vols., Hachette, Paris, 1865. The portion relating to Maté or Paraguay tea was also published as a separate treatise, with illustrations, during the Paris Exhibition, 1867, by Bouchard-Huzard. Robertson, in his 'Letters on Paraguay,' London, 1839, vol. ii., p. 134, gives some interesting details, but it is unnecessary to go back to former years, I prefer to give the present aspect of the trade.

In their wild state the trees are about the size of orange trees. The trunk is about 2 to 3 feet in circumference, and has a smooth whitish bark, and the boughs, which resemble those of the laurel, are leafy and tufted. The leaves are evergreen, and when full grown are about 4 inches long, thick, glossy, and crenate at the edges, of a dark-green colour above, and paler underneath. The flowers are small and white, growing in clusters. The berries are red, very smooth, and similar to the Christmas holly. The leaves of this *Ilex* yield the same bitter principle, theine, which is found in the Chinese tea plant. Although the former may not afford so much of the agreeable narcotic oil as the latter, in consequence of the careless and primitive manner in which they are collected and prepared for use, yet they produce a most agreeable and refreshing beverage, which forms the staple drink of the South American republics.

As far back as the seventeenth century the Yerba Maté was commonly drunk throughout the state of Paraguay. There can be little doubt but that the aboriginal Indians taught the use of this tea to their Spanish conquerors, and the early Jesuit missionaries planted great numbers of the tree before their expulsion, since which time its cultivation has been neglected. The expeditions to collect and prepare it, start from Assuncion, the capital, to the Yerba groves, a distance of 200 miles, and are generally composed of forty to fifty persons mounted on mules having with them other mules and bullocks. On reaching a locality where the trees are abundant, wigwams are erected and the *tatacua* constructed. This consists of clearing a small space of ground, the soil of which is then beaten down with heavy mallets until it becomes quite hard and level; at the four corners of this space sticks are driven into the ground, from which a sort of net made from strips of hide is stretched, a fire is kindled beneath, and the leaves on the boughs, as they are brought in from the surrounding forests, are scorched by being placed on the net, care being taken that no ignition takes place. The scorched leaves and small twigs are then pulverized into a coarse powder by means of a rude wooden mill, and frequently stamped with blocks into dust, after which process they are ready to be weighed and put up into packages for export. Half a bullock's hide in a green state is used to form a kind of sack to hold the tea, being first sewn up at the sides. The tea is then pressed down until it is quite full, the mouth is sewn up, and the package, which usually weighs from 200lbs. to 250lbs., is left to dry and tighten in the sun for a few days, until it becomes as hard and impervious as a stone. Such a mode of collection and preparation is indeed primitive, and the twigs impart a woody flavour to the tea, otherwise very agreeable.

In Paraguay this tree combines, as it were, the properties of cultivated and wild plants. Indigenous to the country, the tree forms entire forests called "Yerbales," in the central, eastern, and northern regions of the republic. The Jesuits, having formed vast plantations of it round their residencies, these have continued, and their produce forms in what are still called the Missiones, the principal article of commerce at the present day. The Government monopoly of the sale of Yerba, and a heavy duty imposed upon its export, formed at one period the principal source of revenue in Paraguay.

There appears to be a considerable difference in the quality and estimation of the Maté, according to the locality from which it is derived; whether this arises from the difference of the plant or mode of preparation does not appear.

That of Paraguay is the most bitter and aromatic of all, and the most esteemed; it yields four times the quantity of infusion that the Mate of the Missiones or of Paranagua does. Hence, although dearer in price, it is the most economic. A coarse kind is made in Parana, Brazil, from the leaves alone, and these being unpulverized, are used in the same way as Chinese tea.

At first Europeans do not like Maté, it having a herby and somewhat bitter taste, but among the inhabitants of South American States it is a much prized article of luxury

* Also in 'Annals and Magazine of Natural History,' 1861, No. xlvii, p. 389.

and necessity, and is the first thing offered by them to their visitors; indeed their tables are rarely seen unoccupied by it; and the "gaucho" of the plains will travel on horseback for weeks, asking no better fare than dried beef washed down by copious draughts of Maté. The demand being great and increasing, there is unfortunately continually going on a rapid destruction of the tree. The Jesuits foreseeing this, started large plantations in Paraguay, and at their branch missions in the provinces of Parana and St. Pedro do Rio Grande, some of which still exist and furnish the best tea made; and of late years some of the landowners, sensible of the short-sighted policy pursued, have established many plantations with the best results, as the quality of the tea improves with the cultivation of the trees.

It is difficult to get at any consecutive or reliable returns for the entire traffic in this commodity, the production of which is carried on in such a desultory and rude manner, and extends over so vast an area of wild country. A careful consultation of the official returns of the several republics and of Brazil, as well as British Consular reports, enables me, however, to make an approximate estimate of the trade and consumption.

Forty thousand arrobas (or 10,000 cwts.) were imported into the Argentine Republic in 1870. In the next two years the consumption was as follows in the Argentine Confederation:—

Description.	1871	1872
	lbs.	lbs.
Paraguay Yerba	260,000	3,356,000
Brazilian "	17,688,000	23,506,000
Total	17,948,000	26,862,000

The total consumption of Yerba in the Argentine Republic in 1872 thus averaged 13 lbs. per head of the population, against 2lbs. of coffee, and only ¼lb. of tea. Altogether nearly 27,000,000lbs. appear to have been consumed in the Republic during that one year. Surprising as this amount is at first sight, it is explained by the fact that Yerba constitutes the only vegetable nourishment of many classes of the community. In the rural districts, as well as the smaller towns, this herb is considered a regular form of diet, and not, like tea in England, a mere accompaniment of the breakfast table. The method of manufacture is to mix ordinary sugar with the decoction of Yerba until a thick syrup is produced, when it is ready for drinking. Probably the nourishing qualities attributed to the herb by the natives are derived from this mixture of saccharine matter. As might have been expected from the prevalence of this practice, the annual consumption of sugar in the Argentine Republic is enormous. In 1872 no less than 20,000,000lbs. of coarse sugar were imported. Refined descriptions amounted to more than 22,000,000lbs., although a duty of 25 per cent. *ad valorem* had to be paid. Viewing the extreme popularity of Yerba in South America, it seems strange that it has not yet been introduced into Europe, as an addition to the food supply.

In 1854 the exports from Paraguay were 85,676 arrobas; in 1860, 174,238 arrobas. In time of peace there is annually exported Yerba Maté to the value of about 200,000*l.*, chiefly to Buenos Ayres. The exports in the three years ending 1863 averaged 4,500,000 lbs. per annum.

In 1856 it was estimated that 6,000 persons were employed in preparing Maté in the Brazilian missions. It is for the most part sent by carts to Itaguy, a small town on the banks of the Uruguay, and from there goes by water to the River Plate. In the year ending June 1858, 2,650,000lbs. were shipped from that port. At Montevideo the Brazilian Maté is preferred to that from Paraguay.

About 400,000 arrrobas (100,000 cwts.), are produced annually in Parana, where it is indigenous; the finer kind is exported to La Plata, the coarser goes to Chili. In 1854 there was imported into Chili 144,792 arrobas.

The official value in Brazil was 13*s.* 10*d.* per cwt. in 1853, and 29*s.* 7*d.* per cwt. in 1856; in 1858 it fetched 32*s.* 4*d.*; in 1863 it fell to 21*s.* 10*d.* per cwt. The exports of Yerba Maté to foreign countries from Brazil have gone on increasing from 181,365 arrobas in 1841 to 605,179 arrobas. in 1863.

From Porto Alegre 83,840 arrobas were shipped in 1862-63, and from Uruguay 27,445 arrobas; there used to be as much shipped from that port as 97,000 arrobas. From Paranagua 404,829 arrobas were exported in 1862-63. Thus the shipments from these three ports in the year ending 1863 amounted to 129,028 cwts. In 1865 the total shipments from Brazil to the neighbouring States exceeded 250,000 cwts. In 1872 the quantity was somewhat less, 200,000 cwts., valued at 251,000*l.*

The following show the exports and value from Brazil:—

Year.	Quantity.	Value.
	lbs.	£
1864	19,553,329	137,306
1865	15,402,899	89,675
1866	22,781,625	147,844
1867	23,370,334	172,104
1868	28,852,460	221,105

Chili is said to take now about 40,000 arrobas, and Peru 100,000 yearly.

It might be worth while to attempt the introduction and acclimatization of so useful and ornamental a tree in some of our British colonies, such as Queensland and Natal, where the climate is somewhat similar to Paraguay. Looking at the use of its leaves, we see no

reason why it should not be cultivated with remunerative profits.

Such a valuable plant, doubtless, is worth the attention of some colonial planters, and with a careful collection of leaves only, and a better method of drying them, the tea would be rendered both grateful and palatable. But we have been so much accustomed to tea leaves being curled up and not powdered to dust, that possibly some prejudice might exist against using it in the form of powder, although the infusion is thereby very readily made.—*Simmond's Tropical Agriculture.*

COFFEE-LEAF TEA.

MR. HENRY COTTAM, of Ceylon, writing to the Agricultural Society, recently, refers to endeavours which are being made to manufacture and introduce what is termed "Coffee-leaf tea." He says:—

One great advantage coffee-leaf tea would have over ordinary tea is, that instead of having a tendency to create nervousness, it contains strengthening properties; this fact was endorsed by a Medical Journal, and quoted by *Public Opinion* as recently as a month ago.

We fancy, however, that a considerable education of the palate would be necessary before a demand set in for this new manufacture, if the following report from Messrs. J. Thomas & Co. correctly represents its merits:—

"Bold, irregular polished, black Souchong leaf, full, strong, nasty flavour, unsaleable. We doubt if this tea would be saleable, having a very common disagreeable flavour."

Tea planters will be under no anxiety as to the probable effect of competition from this new staple; but as some of the curious may like to understand the process of preparation and manufacture, we append the following description:—

Coffee Tea as manufactured in Ceylon by Mr. Henry Cottam.

The best time to gather the leaf is after a few days' rain, to insure the young tip leaves of the "suckers" on the coffee bushes being sappy and suitable for manipulation.

The leaves most suitable are the first pair at the head, which are usually of a golden copper colour, soft, and require very little withering; this discovery was made through my being enabled to make as good a sample of black tea *the same day* as leaf was gathered.

However the leaf seemed none the worse for one night of withering.

Coffee-leaf, unlike young tea-leaf, will not roll without breaking into small particles; fortunately we hit upon a plan of panning the leaf for a few minutes; the result was, it became sticky and rolled without breaking. This I considered half the battle, and with the assistance of my bungalow servants succeeded in making about two pounds of good tea out of about four pounds of green leaf.

In addition to careful rolling, we fermented it in balls for half an hour; this I considered sufficient, as the temperature of the house we used was over 80°.

Both under the process of rolling and fermenting, it presented the appearance of good India tea, and during roasting gave forth a flavour or odour far more pleasant.

Six branches of work are necessary—

1. Gathering in baskets.
2. Withering in the shade.
3. Panning for a few minutes.
4. Rolling until thoroughly wet in its own brown coloured sap.
5. Fermenting according to temperature.
6. Roasting over a slow charcoal fire on perforated tray, and turned occasionally until crisp and black. When packing care should be taken not to use boxes or bottles which have previously contained strong smelling articles, for, like ordinary tea, coffee-leaf tea will imbibe impurities and get damp unless air-tight, consequently losing both strength and flavour.

I AGREE with what you say about coffee-leaf tea, though I think it scarcely merits the term "unpalatable," for it is quite drinkable enough, but on the whole it is a poor wishy-washy sort of stuff, lacking both the aroma of the berry and the delicate flavour of the real tea, and cannot compete with either as matters at present stand. I am not surprised at Dr. Shortt's tea being pronounced unpalatable, for, if I remember aright, the Doctor suggests, in that valuable repository his "Handbook on Coffee," that the planter should gather the old yellow leaves that fall from the coffee in the autumn and turn them into coffee-leaf tea. I should just like to see the Doctor drink a cup of such tea, made from old leaves collected from drains and roadsides. The Doctor further says that coffee tea might be sold for 4 annas a pound, and that at this rate hospitals and poor-houses would be glad to get it. But how can it be sold for 4 annas a pound? It has to go throuhg the same processes as the other tea, and at the lowest calculation it cost 4 annas per

pound for the picking and curing alone. To realize any profit, no tea can be sold for less than 8 annas a pound. I myself would go further and say that, if you cannot manipulate to fetch one rupee a pound, your best plan would be to give up the business altogether. To suppose that in years when the coffee does not bear, a harvest of leaves could be got of it without injuring the trees for the following year's coffee crop is to suppose nonsense. To get the proper sort of leaves of the coffee in quantities worth picking, the system of pruning would have to be entirely changed. At present we prune coffee to give blossom, and tea to give leaf. Properly pruned coffee could not give enough young leaves to pay picking them, and properly pruned tea should not yield any blossom or seed. As a curiosity, I may mention that I have myself made tea from coffee blossom, and the blossom tea I thought quite equal to any tea that ever I tasted. This, however, might be a fancy of mine; but a friend who enjoyed it with me thought it to very good, and preferred to it the real tea.—*Correspondent, Madras Times.*

ANOTHER substitute for tea is also announced, this time, from England. It is obtained from a shrub acclimatized in Great Britain—the *Chimonanthus fragrans*, a native of China and Japan, introduced a century ago. If people in England have been a century in discovering the properties of this plant, there need not be much alarm felt, in face of the enormous present and certain future production of the genuine article.

METHOD OF COOKING TEA

AND OF TEA-DRINKING IN CASHMERE AND TURKESTAN.

WE are indebted to Diwan Pandit Manphul, C.S.I., for the following account of the various processes of infusion and decoction of tea in the above countries. He was sent by Sir John Lawrence in 1867, and travelled, disguised as a *mahajan*, through them; and the result of his investigations was so important that he was decorated with the companionship of the Star of India on his return.

Cashmere.—Bitter tea (Cha Tulch). Boiled in a tinned copper pot to strong decoction, and while boiling, 'Phuli' (Red Potash, found in Balh, a district of Ladak,) 'Bidian katai' (Chinese aniseed), and a little salt are added. It is then poured into a tea-pot of brass, or copper tin-lined, and from thence into tea-cups. The lower class use ordinary stoneware cups; the higher, fine porcelain tea-cups, the latter using what is known as the Russian tea-pot. The tea may be also made in 'Cha Jos' (kettle and tea-pot combined), and poured direct into cups. This tea is used after meals, more particularly after the early morning repast, which consists of plain or butter biscuit and this tea.

Churned Tea, prepared as above, and afterwards regularly churned with milk. This beverage is highly prized, and used chiefly in entertaining visitors; and we have no doubt the Cashmere ladies vent their grievances to sympathetic ears, discuss their bonnets and their babies, and talk scandal over this cup, in much the same way as their English sisters over 'five o'clock tea.'

Turkestan.—Cream Tea ('Vumah Cha'—Turkestani,) also occasionally met with in Cashmere. For this only Black Tea is used. The tea is boiled in a tinned copper pot, and a much stronger decoction made than of ordinary tea, the colour being heightened by spoonfuls being lifted out of the pot while boiling, and let fall into it again. Cream is added to this tea, either while boiling or after it has been poured into a tea-pot. From the tea-pot it is poured into cups. This tea is used in Turkestan in the morning only, bits of bread being soaked into it and then eaten.

Bitter Tea ('Seen Cha'). At other times the Turkestanis use green tea infused after the English method, but only allowed to stand about four minutes. The lighter the colour of the infusion the more highly the tea is valued; indeed, green tea giving a reddish liquor is not *esteemed at all.* This tea is prepared only in a Russian tea-pot, and reckoned a great luxury. Every man who makes any pretensions to respectability keeps a Russian tea-set.

In Turkestan the spent tea-leaves are chewed after meals in the same way as 'pan' (betel) is in India. This is called 'shamma' (residue), and is considered to have much the same effect as the cacoa-leaf of South America to enable one to stand much fatigue on a journey, &c., with very little food. Sir Robert Christison, the great Edinburgh medical professor, reports wonderful results from the use of this leaf by students out botanizing.

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PART II.-TEA BLIGHTS & PESTS.

BLIGHT.

THERE is perhaps no subject of more serious importance to the tea planter than that of blight. Come in whatever form it may, it means very often the ruin of his hopes, and the extent of the money lost which the industry has suffered in the past few years from red spider and other pests renders it a matter of astonishment that proprietors have been content to sit down quietly under the infliction instead of long ere this having organized a searching and thorough scientific investigation into the evil.

The Agricultural Society made some slight attempt in the direction, but broke down for want of funds, being unable, therefore, to procure from England, as they had desired, a skilled entomologist. Government have since promised aid in the matter, but it has never gone beyond the stage of promise; and so probably the matter will remain, and our knowledge of the cause and cure of blights and pests will remain also as it is.

As far as we have been able to stir up discussion, and elicit information on the subject, we have painstakingly done so; and we trust that the following articles, papers, opinions, and selections here gathered together on this most important question of BLIGHTS will prove of much value. The addition to this section of the CYCLOPÆDIA of the colored plates will enable planters to identify the forms of blight prevailing in their district, or to describe others.

TEA BLIGHTS AND PESTS.

BY S. E. PEAL.

FOR some years after this Industry was started, blights do not seem to have been serious, or to have attracted much attention. As cultivation increased, it was but natural that the enemies of the plant should gradually assert themselves, and eventually the "Red Spider" became known.

"Blister Blight" subsequently appeared, and still later "Tea Bug," the latter causing, in some places, serious loss, and spreading rapidly.

Some few years after, the little "green fly," called also the Mosquito Blight and Tea Aphis, developed extensively: the Orange Beetle also attracted attention.

Caterpillar and Borer were known some little time before, but like the case-making grubs of *Psychidæ* that eat leaves and shoots, were less serious pests. Tea proves to be no exception to the rule,—that where any plant is largely cultivated, an enemy will eventually appear; and the steady increase in several kinds of blights becomes yearly of more importance to us.

It is unfortunately true that, in the long run, a serious enemy is likely to arise: larger areas being covered by a particular shrub give to its natural enemies unusual opportunities for propagation. Again, the power of *adaptation* to varying surroundings is a fundamental item in "natural selection" or origin of new varieties, and any insect that, in the constant struggle for life, can adapt itself to "Tea," would flourish at our expense.

Few plants have but one enemy (naturally); generally there are several,—some attacking the foliage, flower, seed, stem, or root; and out of the myriads of insects inhabiting these warm jungles, it would be little short of a *miracle* if *none* could gradually adapt themselves to tea.

With regard to blights that are now common, they may be divided into two classes—insects and fungoids. Roughly speaking (if we exclude the locust), insect blights are easy or difficult to treat according to the *size of the insect.* There are

six or seven kinds of insect blight known, of which three are serious, in order of size, and inversely of destructiveness: they run much as below:—1st, Caterpillar; 2nd, Borer; 3rd, Orange Beetle; 4th, several kinds of grubs, building "cases;" 5th, Tea Bug; 6th, a smaller insect of the same group, as yet unnamed; 7th, Red Spider.

I propose to take these in turn, and, as far as I am able, to describe each, and indicate treatment where possible.

1st—Caterpillar is perhaps not only the largest but the most obvious and harmless of all. It is of a dark brownish color, 2 to 2½ inches long, attacks the foliage only, is gregarious to a remarkable degree; it will completely strip a bush in a short time, leaving only the stems, and is hence easily detected, and clustering naturally, is easily caught. Where at all common, Caterpillars can be collected by children, in small *culsis or gurrahs*, and half a maund of caterpillars per day can be collected by five or six children.

The butterfly or moth is about an inch and a quarter across the wings, and of a dark drab color, destitute of markings.

I do not believe that this pest could ever become serious; the individuals are large, are easily caught, and do not greatly damage a tree; temporary loss of foliage is the limit.

In some years they are rare; in others more plentiful; may be to some extent influenced by climate.

There is one thing in our favour—the probable *natural cure* is not far off. Most birds eat Caterpillars of sorts, and any bird that can so far "adapt itself" as to eat them, would find an open tea garden a fine hunting ground.

2nd—"The Borer" is a semi-transparent red or crimson caterpillar, 1½ to 2 inches long, that bores or eats out the pith of a stem. It is unlike the former pests, inasmuch as, 1st, it works internally or out of sight; 2nd, is solitary; 3rd, generally not seen till some damage has been done.

Its presence is generally known by all the leaves on a stem or bush drooping, turning red, and dying.

The Borer seems to be hatched outside of, and subsequently enters the stem; a hole is always detected from which it works upwards or downwards. It causes far more damage in proportion than caterpillar; each individual, ere killed, generally destroying a plant, tree, or branch. It is fortunate that they are not found in large numbers. Preventive cure there seems none, and all we can do is to carefully cut out and destroy every individual found; but as a pest it stands more chances of causing us trouble. On the other hand, an insect that feeds only on pith, and kills each time the tree it feeds on, would naturally be widely scattered apart.

3rd—Orange Beetle, the third on our list, is an instance where an insect originally used to feeding on other things, can gradually adapt itself to tea. This little pest is a true Beetle, has *jaws*, (and not a proboscis) black head, bright orange hardish wing-cases, and true membranous wings underneath: six legs, black, and the under side whitish; total length say three-eighths of an inch. Naturally it is a grass-eater, and may be found in considerable numbers where larger grasses abound in the open. It has a habit of alighting on the tips, and flies rather slowly, resting under the curved-over tips of "ulu," *Imperata cylindrica* (sun or thatching grass); these insects are at times found in threes and fours, and rest there in the little shade thus afforded. In attacking tea, they generally eat away portion of the *green* stem of the shoot that is just fit to pluck; the shoot falls over, withers, dies, and turns black and dry. If this Beetle is at all common, considerable damage is done, and a garden or patch of tea presents a brown, withered appearance. As the portion eaten out of

each stem is not large, a single Beetle may ruin half a dozen shoots as one morning's work; and, as they are far more plentiful than either of the foregoing insects, they cause a greater amount of damage. Caterpillar eats the old leaf, and Borer the pith of a stem, but this little Beetle at once attacks the portion we require, *i.e.*, the "young shoots," and these alone.

The Orange Beetle, probably *Diapromorpha melanopus*, is readily known from Nos. 5 and 6. It is a true Beetle, *Coleoptera*, or hard *wing-cased* insect. In flying, the wing-cases are opened out at right angles to the body, and do not vibrate, like the pair of larger membranous wings that fold in under the others, when the insect alights. The wing-cases or elytra generally join in a straight line down the back.

Cure.—Eight or ten well-made butterfly nets, depth say 18 inches, and diameter of mouth one foot, ring or hoop of stout brass wire, bent, soldered and inserted in 4 feet light bamboo handles. These in the hands of as many smart boys will bring down the numbers very rapidly. If at all plentiful, a boy can easily "bag" 300 beetles per hour, and where not much of a pest, I have taken several times myself at the rate of 250 per hour. A few days of this, and the nuisance will abate very perceptibly.

It is more easily caught than most insects of this kind, as it flies pretty steadily and slowly; 20 or so may be bagged ere the net need be emptied.

4th.—There are a variety of insects that feed on tea leaves, and make little cocoons or cases out of the leaves or stems.

They belong to the *Psychidae*, a sub-group of the *Bombycina*, wherein the females are apterous, or have no wings, and live in cases, one or two inches long, made of pieces of leaf, stem or grass. I have seen other varieties having grass cases 4 inches long. In each instance the particular variety adheres to the one material, and form, thus:—One that feeds on tea makes the case of small pieces on leaf, which it also feeds on; another makes its case of stems only. These pests are at times very troublesome *in places*. I have never seen them at all general; and, as they move very slowly, the females can be easily caught. They are not likely to do us serious damage.

This closes the list, as far as I know it, of insect blights or pests that are not really of serious moment. We now come to the three that are of great importance, least of which perhaps we may rank the "Tea Bug,"—No. 5.

This latter and the *Tea Aphis*, No. 6, are insects nearly allied to each other.

The Tea Bug has no jaws—only a sucker—belongs to the Hemiptera, wherein the wing-cases are half like wings, and used as such, and vibrate. Also, half the outer wing nearest its insertion is hardish, and the tip is membranous. In folding the wings, they cross each other; hence the winged bugs have a cross on their backs like an ×, and are known from the Beetles at once, where the wing-cases join in a centre line like an I.

The "Tea Bug" is, when full grown, not unlike a large mosquito; when very young, it may, after some trouble, be seen running (often sideways) on the young leaves and stems of tea—say it is less than one-eighth of an inch long, and of pale green color.

As it grows, it turns darker (tea-liquor color); and a pair of long antennæ are developed.

Its presence may be known by the small brown punctures closely made in the younger leaves; and, as it grows, these punctures become larger and wider apart. If recently made, the spot is pale greenish brown, turning bright, and then dark brown; and when many are on one leaf, it generally dies. Eventually the Bug turns to a deep black—head, legs, antennæ, and thorax; the abdomen to opaque white. It has a small spine on the back, like a drum-stick. The damage caused by this insect is, I think, much greater (when it *does* appear) than all the previous ones together. I have seen the greater portion of a large

garden so bad with it, that 35 acres of the worst part was heavily pruned in July, the Manager quite disbelieving that the "blight" was caused by any insect; and it can quite upset an estimate to the extent of probably 30 per cent. of outturn or more.

Luckily it is not steadily increasing, but seems more or less influenced by climate or season. In one year it may be bad, and in the next hardly make head at all; or it may shew in one part of a garden and not in another.

As a rule, shade favours it; it is generally worse near the edges of forest, hoflas, or under large trees. The only and nearest approach to cure that I know is the removal of all shade: at the same time I am aware that it is often bad in the open as well. This will hardly sound like a "cure."

In this case I do not believe there is one, until the Bug's natural enemy (and we may be certain it *has* one) makes head. Possibly to this cause we may attribute the fact that it is not now an universal and serious enemy, for it has everything in its favour—propagates rapidly, and can elude us like the mosquito, which we might equally in vain hope to exterminate.

The effects of the Bug on tea shoots, and other detail, need hardly be gone into here; they are given more fully in the Journal of the Agricultural and Horticultural Society, Vol. IV, part I, N. S., wherein this blight and some of its effects are illustrated.

The *Hemiptera* are divided into two groups, called the "*Heteroptera*" or true Bugs, and the "*Homoptera*" (that also live by sucking), wherein the wings do not cross, but stand up more or less on edge. This latter group includes plant lice *(Aphis)*, *Cicadæ*, &c. To this group belongs our No. 6, or the "*Tea Aphis*," which is for several reasons a more serious enemy than any of the preceding. It is smaller, and propagates with such rapidity that for many years it was a mystery to naturalists how such enormous numbers could be produced in so short a time. The fact is as follows, as regards *Aphis* generally:—In the autumn the perfect males and females fly about, and the latter lays 600 or 700 eggs in the cracks of the bark: in the ensuing spring these are hatched out and are *all females*, without wings. In 8 or 10 days these are full grown; and at once, without the intervention of a male, begin to lay, not eggs, but hosts of young *Aphis, ready hatched!* each of which in 8 or 10 days again repeats the above, and for some 8 or 9 generations!! Towards autumn the last brood turns out mature males and females, and the latter lay the *eggs* for the ensuing year.

This is lively news you will say; but in the main it is, I am afraid, true, and that this pest, of itself, is quite capable of exterminating tea as an industry.

But the regular course of things in Nature again comes to our rescue. Not only are small insects much more subject to various changes of climate and season, but the more an insect propagates, the more certainly it encourages its enemy in turn, till the balance is restored. To this we must look, and on this mainly rely. In all the smaller blights due to *insects*, we may slightly mitigate, but we cannot *cure*.

To describe this *Aphis*, when mature, it is from $\frac{1}{8}$th to $\frac{1}{6}$th of an inch long, and of a glistening pale green color. It is not easily caught, as it runs rapidly sideways, can jump to some distance, and flies quickly.

Unless under a microscope, detail cannot be seen; but I may say it has six legs—the hinder pair longer than the others, covered with small spines, and more suitable for jumping; the head is large, and eyes prominent,—not unlike the head of a grasshopper. Wings four; hinder pair transparent, and extremely delicate; the front pair semi-transparent, and pale green; body small, and extremity turned upwards, about half the length of the wings.

The proboscis is shorter than in the Bug, and more tapered; antennæ about the length of the head.

When young, it can hardly be distinguished from a small Tea Bug, either in habit or appearance, which might have been expected, seeing that they are closely-allied forms, as specific distinctions always become more developed in the adult, and can hardly be traced at all in embryo.

In attacking tea, the young leaves and stems alone are punctured; growth becomes remarkably arrested; the internodes or stem between the eyes becomes shortened; and the leaves present a paler dwarfed appearance. After a time they fall off, and the stunted bare little shoots proclaim the blight at once. There is less mark left than by the Bug, and the effect is mainly to dwarf the growth and shrivel up the young shoots. I do not think that questions of "soil," manure, &c., have very much to do with either the cause or cure of these *insect* blights, though it probably has with fungoid ones.

The climate has far more effect. A hot or cold, wet or dry, season will influence the propagation of an insect that feeds on a plant above ground, far more than the quality of soil or kind of manure.

At the same time I may mention that this "*Tea Aphis*" is new to us at the eastern end of the Sibsagar District; it has come gradually from the west. It offers some peculiarities that perhaps may be made in the end to tell in our favour.

We now come to No. 7, the last, and least as far as size goes, but the greatest "pest" of all; *i.e.*, the Red Spider.

It is not only the oldest, but most universal of all our blights; probably also it is one of the most widely-distributed of the insects, is known to range from the sea level to the regions of perpetual snow, and was seen by Dr. Hooker on the Donkia Pass at 18,000 feet elevation.

It properly belongs to the subdivision of the spiders called "Acaridæ," or Mites, that have the head, thorax, and abdomen all fused into one, (and of which the ticks are the carnivorous representatives.) The Red Spider is oviparous, *i.e.*, lays eggs.

This pest generally shows in the open in the early part of the season, and attacks only the older leaves, causing them to turn a reddish or coppery color. Considerable damage must be done to the tree, as growth often stops entirely for a month or so. This represents probably five flushes or more, as it will take some time ere the tea afterwards takes to flushing regularly, and possibly curtails profit to 20 per cent. or more on the one year's operations—causing in some cases perhaps actual loss. The insect itself is extremely minute, barely seen by the eye, of a reddish pink color, has, like all spiders, 8 legs, and spins an extremely fine, irregularly-laid web, which in misty weather can easily be seen on the upper surface of the leaves, and *beneath* which it runs about.

It is seen on all kinds of tea—Assam, Hybrid and China; and in hill or plain gardens, it is equally a pest seemingly on any kind of soil,—clay, loam, or sand.

It does not, however, confine itself to tea, but is found on the Roghú or Kodúm, *Nauclea kadamba.* Whether it came originally from it and took to tea, or has gone from the tea to the Roghú, I cannot say; but it could be, perhaps, settled by an examination of Kodúm trees in a province where there is no tea.

The eggs are microscopic, small transparent red spheres, and deposited under the web on the leaf, *singly and not in clusters*. Like all spiders and mites, the skin is frequently shed during growth. At first the egg is semi-transparent, and seems filled with red liquid; gradually it turns paler and more opaque; a skin is shed, and it then shows (or before being shed) a single spine standing out equal to a diameter of the egg. Again a skin is shed, and the little mite is seen of its normally (egg) shape; the cast off

skins are white and scaly, and can be seen of all sizes.

In feeding, the forceps are buried in the substance of the leaf, and the cellular tissue and juices eaten or sucked out—each part so eaten turning red ;—young leaf is not eaten.

It is often supposed that the eggs are laid in the ground : this, however, is not the case ; some may fall off the leaves, but this group almost always lay them on leaves and bark ; and as these eggs are seen on the leaves of tea in large numbers, we may safely infer that the Red Spider is no exception to the rule.

It is a singular fact that in a new clearance or garden, having plants, say a year old, a single one may often be seen attacked by spider, and none visible after careful search anywhere else near within 500 yards or more.

As this is not a rare phenomena, it would at once point out the mode of propagation, *i.e.*, *insect agency*, as flies, bees, or beetles, &c., the little eggs adhering to their feet, and being thus carried about. There is evidence that in some of these cases they could not be carried by the wind ; indeed the eggs are not so easily detached, or so light as to be thus transported. If this can be, in any case, *demonstrated*, a certain step is gained which may be of future use. With regard to a cure for this blight, there are probably hundreds searching for one ; some are trying one thing, some another, and in the end it may be found. Additions to the soil, however, are hardly likely to affect it ; any chemical added thereto that would kill the spider that lives on the juices would probably *do for* us also, and our industry. We must seek an external and not an *internal* cure. Syringing with liquids is possible ; but, I need hardly say, it is an expensive process in a climate where the trees are thoroughly washed by a deluge of rain so often.

I may also mention in passing that the heaviest rain experienced, if continued for nearly two days and nights, would seem a likely way of drowning them clean out ; but after it, I have gone out and found them *as lively as ever*. Drowning will not pay.

Heavy pruning, and destruction by fire of the prunings and all the remaining leaves, would probably be the most likely way to destroy the eggs in the cold season ; and any spiders left would fare badly for food. It is also the best time of year, as the manufacturing season is over, and work less pressing. It also would fit in as a part of our regular routine, and not be a new feature in our cultivation. Tea is now ever green, and hence favours the propagation on the foliage till the next year ; but by imitating a deciduous tree, we may possibly cripple it. I purpose trying this on a piece of tea land this cold season, and deep hoe, as the prunings are taken away, so as to bury or destroy as many as possible of the spiders or eggs that may fall off. Allowing some tea to get into jungle towards the end of season, cutting it and the trees down, and firing all, in say November, might, in places where spider is very bad indeed, be still better ; the stumps would begin to shoot again in January, and by June be fit to pluck, if not before. Birds have nothing to do with spider,—directly at least ; so the gun is not to blame. If anything eats the spider, it will be another *insect*, and not a bird.

BLIGHTS.

THE following contains selections from the correspondence which has passed on this subject :—

I DO not think that Mr. Peal has noticed what may be called a blight for want of a better name, which is unfortunately very common on some gardens in Cachar. It is probably a larger species of the *Psychidæ* family referred to by Mr. Peal, and constructs its case of both leaves and small twigs. It grows to a length of about 1½ inch ; and instead of attacking only the leaves of the tea plant, it attaches itself to the stems and lower branches, from which it eats away the bark, when, of course, the

upper part of the plant attacked dies off. On some gardens, at certain times in the year, the injury caused by this larva is very great, and children are frequently employed for days together in picking them off the plants.

Another blight, which Mr. Peal has omitted to notice, is the Cricket, which is so common and destructive in Cachar. This insect is about 1¼ inch in length when full grown, and lives in small burrows, sometimes singly, sometimes two or three in one hole. The burrows frequently penetrate to a great depth and where the Crickets are so numerous that it becomes necessary to dig them out (which sometimes happens), the tunnels are followed a foot and a half or two feet, and even then not uncommonly without avail. The Cricket feeds on the young leaves of the young plants; and to obtain these he cuts through the stem of the plant about three-quarters of an inch from the ground, and then carries off the top to his hole, so that each meal which the insect makes causes a vacancy; and where they appear in any number, the destruction may be imagined. They will cut through a stem as thick as a pencil without difficulty, and amongst small plants in a nursery they sometimes do incalculable mischief. I have seen them attack an old garden, where they ate off the young shoots, and thus did a great deal of harm to the succeeding flushes; but I have only once seen this occur.

While so much interest is absorbed in the "Red-Spider" question, I am surprised to see that no one has put forward any cure for it, except indeed Mr. Schrottky, who has, as far as I can judge, arrived at neither cause nor cure. In Cachar the custom is to make a tolerably stiff solution of clay, which, on a bright sunshiny day, is sprinkled thickly over the leaves of the bushes attacked: this dries very rapidly in the sun and the "Red Spider" is dried up with it. After the first heavy shower both the clay and the spider will be found to have nearly, if not quite, disappeared.

A recent issue of your paper contained an article headed "Tea Blight by a Darjeeling Planter"—in which the use of salt is recommended as a means of driving away some of the small insects which settle upon the tea plant. The author says "the salt was given at the rate of two maunds an acre for each application, and given four times during the plucking season." Now as the commodity in question costs four annas a seer here, four times two, that is eight maunds of it, represents 80 rupees: a pretty tidy expenditure per acre for material only. And what does it cost to apply it? He might have told us this, especially as he distinctly informs us that it does not effectually rid us of the insects. He says: "It drives them away grandly for a time, but they come back again." The same article also contains a suggestion for dusting the tea plants, first lightly and afterwards heavily with lime—another rather expensive material in this district. The author does not say how many maunds of this he recommends to the acre.

In the *Indian Tea Gazette* of 4th July the article on Red Spider has attracted my attention. The subject has caused me much interest, as I have had opportunities of seeing the destruction in gardens adjoining mine. Mr. Schrottky gives it as his opinion that the Red Spider is nothing more to the tea plant than the maggot is to putrefying animal matter—"the same natural law governing both phenomena." Now I wish to make this a matter of enquiry, and shall be glad if you or any of your readers solve the problem for me. It is well known that the appearance of the Red Spider in one garden, and not reaching to the adjoining gardens, has been a puzzle to many, and might be accounted for if Mr. Schrottky's opinion is correct, that the cause arises from a peculiar condition of the sap in the plant: hence a natural supposition is, that the plant is sick; it must therefore be nursed up—the medicine to be the particular chemical, animal or vegetable manures known to practical gardeners as conducive to the health of plants. But this is the problem. A neighbouring garden has been picked for years, and no manure or other nourishing food been administered to the plants, and when the Red Spider showed itself on this garden, Mr. Schrottky's opinion might be right in this instance (poverty of blood, as medical men acknowledge, conduces to ailments;) but now the neighbouring gardens, which have been treated with no more consideration for the health of the plants, ESCAPE; *and Red Spider is found unmercifully exhausting the plants of a garden which for years has received all the high cultivation so strongly recommended by Mr. Schrottky.* What lesson are we to draw from this result? Is it the same? I believe medical men allow, that poverty of blood, or too high a state of blood, engender the same diseases; and is it that poor or too rich sap in a tea bush cause the appearance of the Red Spider? I doubt it.

Another puzzle to me this year has been what I only once before remarked in 1873 or 1874 (unfortunately, I did not make a note of the year), when, after the usual pruning and gathering of the first crop, the leaf buds, just at its expanding for the second crop (from some atmospheric cause, I believe) stopped growth by a sudden check, and the leaves turned hard and not fit for picking. Some of us began re-pruning, some picking off the old leaves, to promote growth, but by none of these experiments did I find a benefit; and it was fully six weeks before the natural flush came on, and the sap in the plants began to act. This year I have had to deal with the same phenomena. I remark that, in the letter above-mentioned, some one advocates late pruning. This in my case this year would have been ruinous, for I believe had I not pruned when I did in January and February, I would not have been able to gather the heavy crop I had at the beginning of the season.

IT is a well-known fact, that every plant, —nay more, every living thing under the sun—is liable to be affected by wind and weather; and in consequence, I imagine that the tea plant is subject to be attacked by Red Spider, as in any other plant by other pests. The Red Spider and blight are both brought on, I should say, through *sudden* changes in the weather,—of excessive moisture or drought, as the case may be; and I can't fancy that the fault lies simply in "soil, sub-soil, or class of plant cultivated."

For instance:—This appears to be a season in which plantations in the North-Eastern district of India, which lie pretty nearly in the same latitude as each other, *viz.*, Assam, Cachar, and Darjeeling, have suffered more or less from the above. Now, if planters in either of these districts are in the habit of keeping a memo. of the state of the weather, on referring to their books, I shouldn't be at all surprised to find that they tallied pretty correctly with regard to having experienced, at the same time almost, during the past cold season, a continuance of severe, cold, wet "*gloomy*" weather, accompanied by "*Easterly winds.*" (This is when the mischief is done.)

Should such weather again be experienced, I would strongly recommend that "*cold ash be sprinkled over the leaves of the plant.*" It is a sure preventative, and I have found it to be the best thing in arresting the progress of any pest. It must be done, however, in the proper time; *i.e.*, during the weather above alluded to; and it must also be remembered, that doing a thing by halves is one thing; to do it properly is another; and a third, to over do it.

My opinion is, that blight by Red Spider, at least in the Darjeeling Terai, is simply caused by *hard plucking with very low cultivation* (*i.e.*, plucking as hard as possible,) and neglecting in the meantime to supply the plant with proper food, in the shape of good manure, after destroying half its life by tearing away nearly all of its lungs (the leaves) during seven or eight months of the year, and then, instead of giving the plants a good rest and plenty of *food*, and assisting it to recover its former strength, as soon as the plant has, through sheer weakness, stopped flushing set to work and cut off, I mean hacked off, as roughly as possible, all its young wood (and called this operation *pruning.*) Hoe up, as deep as you can, so as to effectively expose to the sun all the unfortunate plant's surrounding soil, worry it in every possible way, and don't give it a moment's rest; and can you wonder then at Red Spider? advice to proprietors and managers is:—

Cultivate your gardens better.

Pluck the plants according to their strength, and supply *each plant* with proper manure, and give it sufficient rest; and this, in my opinion, is the only way to keep Red Spider away from your gardens, and so of course to make tea pay as it should.

I HAVE studied this subject long and closely; cures will hardly be offered or *nil*, where the *value* is so great; but I know of none so far, nor do I think a "*cure*" at all likely.

I have shewn the eggs to several; they are on the leaves separately, and not in nests—are *microscopic*, and in *millions*. If water could kill the spiders, some of our showers should. After 6 hours' continuous deluge I have gone out expecting to find all forcibly washed off; but no: all there and lively as ever. They live under a web; hardly seen but in dewy morn.

I CAN vouch for one property in this district, which received as high cultivation as it is possible to give. By high cultivation I mean the garden was well and thoroughly hoed four times between January and May, and scarcely a weed was to be seen on any part of the garden, and the parts most affected by the spider had been most carefully looked after, and each plant *individually manured* by prepared cattle manure. I think this is

a sufficient refutation of that theory. I have carefully watched the movements of the spider this year. I had plenty of it, for in a large portion of my garden it was easier to count the green bushes than the red ones. I will now give you the result of my observations, trusting that they may lead to some practical results, which may tend, if not altogether, to rid us of this increasing pest, at least to lessen it in some way.

In the first place, I noticed the spider commenced on the garden first pruned, and seemed to attack each garden in the order it was pruned.

Secondly.—The garden, most attacked, had the largest quantity of *bhànji* shoots.

Thirdly.—The spider seemed to travel from east to west. I noticed this particularly here. Now, as I am not either a practical gardener, a botanist or entomologist, I am unable to draw a scientific reason from my own observations. I only hope that some others may be able to do so, and be induced kindly to come forward and help the planting community generally.

There are one or two questions I should like to ask.

1st.—Is the spider the cause or the effect? That is to say, does the spider attack a vigorous healthy plant and thus check its growth and vigour; or, is it the natural sequence of the plant being in a weakened state by heavy plucking and pruning?

2ndly.—Is the spider a parasite?

3rdly.—What becomes of the spider after it has committed its ravages?

I confess I am utterly at a loss to account for it in any way.

Perhaps some of your readers may be interested to hear of yet another pest in Assam.

Lately part of my garden was taken possession of by many thousands of locusts, apparently the same as those I have seen in flights in the hills of the North-West; they averaged about 2 inches in length, bodies red and black, wings drab, double pair like beetles.

These insects did not feed on the tea (this is known), but they seemed to prefer the bushes to live upon, and they did a considerable amount of damage by walking over and apparently mouthing the young leaves, which, wherever the locust touched them, turned black and curled up.

Some deep pruned tea was seriously checked by this.

We are very much obliged to Mr. S. J. E. Peal for his description of the various blights. There are several other insects very prevalent in some gardens: one kind brought to notice by the "Darjeeling News," and another a caterpillar that eats between the two skins of the leaf, causing first a brown round patch in old leaf, which afterwards gradually extends to the whole leaf. But before proceeding, we ought to have some definition of the word Blight.

Blight embraces a vast number of minute insects which come from no perceptible cause, and which are found prevalent mostly in spring when the wind blows from the East, and the weather is moist and foggy. It is a great pity that Mr. Schrottky never went to Assam, as it would have given the public greater confidence in him.

Let us hear what Mackenzie's famous book of 5,000 recipes, revised by an American Physician, says upon Mildew, Rust and Smut in Wheat. "1st edition, 1829. copyright secured in 1829":—"All the different disorders are generally accompanied by insects, which animalculæ, by many people who take the cause for the effect, are considered, though without the least foundation, as the authors of the mischief that follows. Their appearance, however, may justly be attributed to the diseased state of the plant, for wherever putrefaction takes place, either in animal or vegetable substances, the presence of these insects will never be found wanting."

Again, "blight originates from moist or foggy weather and from hoarfrost, the effects of which, when expelled by a hot sun, are first discernible on the straw." Many persons are astonished that blight should very often be found in very young plants, and suppose that, because they are young, they can have no disease. Of course it is scarcely to be credited that young plants should be more unhealthy than old plants. But in the old style seed was so carelessly sown to save expense, that one could scarcely credit that any native could sow so badly. But this is done by educated Europeans; the soil is scarcely dug—perhaps hoed three inches deep, and the sower believes he has dug six inches. The seed is then chucked on to the land almost in heaps—I say so, for each seed is touched by three or four others. Then a trench, called a path, is dug, and the earth from it thrown on to the seed. The seeds, being close to one another, quickly germinate, and the plants grow so close, that no wonder they are yellow, sickly, and unhealthy, and that spider blight and other blights make their appearance. In transplanting, many of

these plants die shortly afterwards. Those that survive take a long time to recover. But where nurseries are properly sown in rows eight inches apart and two inches in the row, then rarely are the young plants diseased.

Let us follow the young plants to the field. There, on account of either a bad supply of labour, or the shortness of funds, the ground is rarely properly prepared; the jungle is hurriedly cut—sometimes covered by a clod. If light rain follows, this jungle becomes sour and putrid; and so the plants are planted in the midst of putridity.

This I have seen on my own land; even healthy young plants transplanted into the midst of these overturned clods (the under-portion of which is green grass) became often affected with spider blight.

Perhaps Mr. Young, whose gardens of young plants were attacked by spider blight, will give us the history of how his plants were sown, either seed, at stake, or transplants; and whether the garden was clean or foul with half-buried weeds, and the rain not sufficient in volume to wash away the putridity deep into the soil—that is only drizzling rain, called moist foggy weather.

Let us see what Mackenzie's receipts say upon this subject called Rust. [Dr. Aleyboom of Java calls it "rust" also, while we call it "spider blight."]

"The only remedy in this case—and it is one that cannot easily be remedied by the hand of man—is a plentiful supply of moisture." Not that the rain washes away the spiders or mildew or smut, but it purifies the roots, and washes away the putrefaction there.

Against mildew this book recommends salt water, one pound to a gallon, sprinkled over the wheat, close to the roots, with a white-washer's brush; and says that one man can do ten acres per day. Two hogsheads are said to suffice for one acre. I found that a very much smaller quantity of salt-water was sufficient to drive out the Tea Aphis No. 6 of S. E. Peal; but I gave it up, as it required about 20 men with watering-pots so as to drive them in one direction towards the jungle, and I had only one watering-pot. I should say one maund of salt to the acre was sufficient to treat the leaf; but 6 to 8 maunds per acre for the root. In England the favourite manure is bone-dust, salt, and guano; the salt is given for purification and hardening, and also for lengthening *the stalk*. What better could we have for giving long succulent flushes. For smut one of Mackenzie's recipes is lime. The wheat is washed in it before sowing. Here, then, is lime at the roots, for purification hardening, and for killing young insects.

Finding that I was foiled in using salt to the leaves, I used lime. I had to re-dry it first, and I dusted (while the trees were wet with rain) very heavily—42 maunds of damp lime to 16 acres. Thus we might calculate upon 2 maunds of *dry lime* to the acre; but then my trees are very thickly sown—5,000 to 6,000 plants per acre; ordinary acres would take 1½ maunds; so this is not a very extensive item. But salt ought to be much cheaper when the duty is taken off, as it should be for agriculture—and as it is in France and Germany. Where railways and steam boats are multiplied, salt should not cost the planter more than Rs. 2 per maund. Rough Bombay sea salt sells in Calcutta at Rs. 50 per 100 maunds, or eight annas per maund at the ship's side, and the inland transit should not cost Re. 1-8 per maund. Lime costs with us Rs. 2-12 per maund in Calcutta. It was not Re. 1 per maund in olden times; it cost then Rs. 30 to Rs. 40 per 100 maunds, and it ought to be obtained at this price in Cachar and Assam.

S. E. Peal recommends the cutting of the trees to the ground, and burning the jungle and bushes together; but Dr. Aleyboom tells us that, after trees had been so treated, spider blight made its appearance in the third flush. In Darjeeling, with trees cut to the ground, it made its appearance in the second flush,—a positive proof that the disease was in the root.

We ought in the cold weather to dig about the roots,—perhaps open the roots as is the custom for all Indian fruit trees, and treat them to lime-water or salt-water; and in the season of pruning, every leaf cut off should be burned. The trees should first be pruned, and every remaining leaf cut off and burned; for, although the first generation is destroyed, yet from the eggs the second generation is now in full play; and often, if the root is healthy, a new spider blight commences in the next flush.

The plains abound in mangoe-orchards, and yet how few mangoes come to market. Go to a mangoe-orchard and you find it swarming with insects. In spring the whole country is scented with the perfume of the blossoms, and then comes the easterly wind, moist and foggy;* smut makes its appearance, literally blackening every leaf like soot, and then comes the cry: "No mangoes this year." What

say the British Farmers—"When the wind is in the east, it is neither good for man nor beast." Look at the beautiful cultivation of the land for indigo by the Tirhoot planters:—not a blade of even dried-up grass to be seen; the soil ploughed eight times and hoed once, so as to give plenty of sun; and yet often the report comes that the crop is dreadfully eaten up by caterpillars. Where did the smut and caterpillars come from? That insects are in the air, and appear to live in the air, we have only to mention the swallows, who are on the wing all day long. Who has ever seen these insects? I believe few only:—he whose curiosity has led him to shoot a swallow, and examine its crop.

I think Mr. Schrottky is partly right in advocating this peculiar manure "poudrette." Tea is a green-leaf crop, and therefore this manure is especially adapted for this purpose. We have only to learn the extraordinary crops obtained from grass lands to which it had been applied in England, not to doubt it. That there is a difficulty with the coolies I know, but I think this might be got over with a little address and money.

When the rage for sugar cultivation took place in Tirhoot, the necessity of manure was quickly felt, and many resorted to bone-dust. Here the coolies also struck work; but by hiring men of low caste to put the bone dust to the roots, the coolies covered it with earth, and there was no further demur on their part. On asking the Tikadar, a Rajpoot or a Brahmin, to dig up the cane seed (that is a piece of cane), to discover the reason of non-germination, he dug it up, and handed it to you, expatiating on the wonderful desire of the roots for the bones which adhered to the rootlets.

We have also another pest here—the grub, which is to be found at certain elevations in thousands—the progeny of beetles. In the local paper some one recommended a flock of ducks to be kept, but unfortunately for his theory their bills will not go six inches deep. All people are alive to usefulness combined with economy; and if the ducks could dig as above, then the European assistant and malee coolies could be dispensed with. I offered one pice for 30 grubs: this made the coolies so eager, that they dug up double the extent of land which, without this stimulant, they would have not done; so I spent not one extra pice. To clear 15 acres cost me in pice Rs. 108—giving 2 lacs of grubs, which filled two hogsheads. The eggs from which these grubs sprang must have been laid some two or three years before, and most likely they have quietly been doing great mischief. I am in the habit of burying the jungle—not all over the land, but in small holes, here and there, where convenient. This I found a great trap; for the grubs left the tea trees to attack this rotting vegetation, and so were easily collected.

Several letters have appeared respecting the various blights of tea so very prevalent this year, but no one has as yet suggested any practical remedy against them. One suggests that the gun has been used too much in killing small birds; this is not the case in one part of the world (Darjeeling): another that we should harden our plants, &c., &c. This is a very good idea, but these blights do not attack the old wood of the tree, and if we were to harden the young flush, we could not make good tea of it. We want very succulent long flushes to make good tea; we do not want hard leaf which would only make red leaf tea,—that certainly would not pay. Most of these blights are so numerous and *so small*, that only swallows could attack them with any chance of success. They do not each attack the whole of the plant, but each one different parts. One attacks the delicate leaves and buds of the flush just starting, called the mosquito blight (this is a very small mosquito kind of fly); next the red bug of the size of a ladybird (it is really a red beetle) attacks the stalk of the half-grown flush and soon makes it topple over. The spider blight is a very small red insect,—considerably less than the size of a very small pin's head, which lives principally on the older leaves, commencing its attacks underneath the leaf. Then there is the blister blight, exactly as though a red hot iron had been placed close to the leaf and scorched it black. But one of the worst pests is a very small black fly less than half the size of a pipsa, which attacks the stalk of the young flush and retards its growth wonderfully, giving the tree something of the look of a bhanji flush. There is no doubt that most of these blights are brought up every year, more or less, by the winds from the plains and the Terai. The rain at the commencement of this season did not allow of the usual burning of jungle to the extent of former years, and the rains since have been very slight;—no heavy down-pours which would have drowned most of these small insects called blight: so that they

have increased and multiplied, and become perfect pests. I have large forest trees both in my house garden and outside, and also toon and other trees in the forest completely denuded of leaf by small invisible insects. These cannot have been deteriorated by over-plucking, since rose and other garden-plants and peach and filbert trees are also suffering in the same manner,—while the willow, pear, fir, and other trees are not as yet touched. Fumigation drives away for a time the mosquito and the other smaller insects that have wings, but only to settle in other trees a little further off; it does not kill them. Watering with salt water (a weak solution) drives them out grandly for a time, but they come back again.

The salt, if a weak solution, does not hurt the leaf, but helps to strengthen the root, as it must eventually be washed there by the action of the rain. I have in healthy seasons sprinkled salt on the ground at the root of the plant, and it has had a very good effect in lengthening the flush. The salt was given at the rate of 2 maunds per acre for each application and given four times during the plucking season. I would recommend it as one of the means of hardening and strengthening the plant, without deteriorating the flush. I was recommended to water my trees with lime water, but considering that to carry the water would be a great trouble and expense, I commenced to dust the plants with lime, leaving it to the clouds to furnish the water. From dusting lightly I changed to dusting heavily. I noticed that the light dusting did not appear to hurt the plants; therefore, I plucked clean, and dusted with lime heavily. This appears to have driven away every insect clean out of the tea trees. It is yet to be seen whether it will improve or spoil the next flush. Trees sheltered from the wind from the plains appear as yet to have escaped the various blights.

One can scarcely believe how harmful are the attacks of these small insects. The coolies of this part of the world (pahariahs) all wear trousers, which plainsmen despise. Having to clear a little piece of ground, in my garden, and wishing to do it before evening, I called a plainsman to assist: he only wore a *dhotee*, and, consequently, was soon slapping his legs, on account of the pipsas, to the great amusement of the pahariahs. These pipsas also attacked my hands, and produced very great irritation. I can quite believe that some of the tea trees are almost, one might say, stuifg to death. Any one fresh from England, smarting from mosquito bites, can readily believe this. We cannot understand that jungle has any advantages; but I believe it has one,—that of being food for insects. It is well known that when grass is destroyed, then the grubs begin to attack the roots of the tea plant. One can scarcely understand that such a bitter shrub should be naturally sought for by insects. Indigo and tobacco are, I believe, also eaten; when green, by caterpillars, and if they have not their natural food, they will eat anything else that they can get hold of. Flies like tea in the tea-cup; they may be attracted by the sugar and milk, but it is death to them.—*Darjeeling Planter*.

"CHINAMEN in California export large quantities of the shells of the shrimp to China, where they are used as a manure for the tea plant. 'Chinamen say, it is the only remedy known for the tea pest.' The matter is curious, if true."

READ the following extract of a letter from Mr. A. Grote, in reference to the specimens of blights and insects referred to in the Proceedings of June and July last:—

"I saw Mr. Moore to-day and showed him the specimens of blights and insects enclosed in your tin box. The so-called blight sent to you by Mr. Pinney is the larva of a Flata which covers itself with those long white plumes. It is an homopterous insect allied to the wax insect of China, and the plumed larva is always to be found in the insect collections sent down in boxes from Eastern Bengal. Feeding, as it does, on jungle plants, it will prove probably to have been only an accidental visitor to Mr. Pinney's tea garden.

"The green beetle sent to you by the Mungledye Company is a *Curculio*, allied, as Moore thinks, to *C. tanymecus*, but these beetles ordinarily bore into the stems and branches of plants, and do not meddle with their leaves.* Of these last you sent me some specimens, which undoubtedly had been pierced by insects; but is it certain that this particular beetle did the mischief? Our scientific committee has not yet commenced its sittings, and I have, therefore, been unable to consult them. Still the whole family of weevils should, if possible, be kept out of tea gardens. I hope Mr. Pinney and the Mungledye Manager will keep you informed if these pests show themselves a second year."

In connection with the above the Secre-

tary submitted the following extract of a letter from the Manager of the Kunchunpore Tea Company (Cachar) regarding the mosquito blight:—

"With reference to your letter of 14th instant, regarding the cure of blight on the Lydiacherra Tea Estate by cutting the jungle round the tea, I beg to inform you it has been tried on various gardens without the least effect every year since 1867, and the estate mentioned not having suffered severely this year is one of the peculiarities of blight which baffles all attempts at understanding it. I know gardens that have no jungle whatever round the tea, it having been all cleared out, yet the blight is as bad as when the jungle was there. With reference to next year, I have not experienced two successive years of severe blight, and there is no doubt the drought, &c., had great deal to do with its being so severe, and we are not likely to have two successive bad seasons either; a good one has hitherto followed a bad, as witness 1867, 1868, 1870, 1871, 1875, and 1879. With reference to the cure of blight, all we have found out is, that it is an insect resembling the mosquito, and as numerous; any number can be seen any day sucking the juice of the young leaves, but where it lives, lays its eggs, &c., and at what season, is only a conjecture. The loss by this pest is so enormous that I know companies who lose from 40,000 to 50,000 annually by blight alone."—*Agri-Horticultural Soc. Jour.*

It is of the greatest importance to banish the vulgar notion about "blight." There is no such thing in the sense commonly entertained, *viz.*, "that these pests are the result of some particular state of atmosphere (electric), combined with easterly wind and fog when 'blight' comes," the real state being that the warm and electric condition of the air hatches the eggs of the various pests, some into larva, worm, or caterpillar, which pass through the stages of chrysalis and moth, which deposits its eggs and dies; others, as the arachnoids, are hatched from the eggs into their final state, as the Red Spider, which attacks the hops. They spin the moment that they are hatched and are fully organized. The important thing is to study the habits of each insect, to trace where and how it deposits its eggs, and at what stage of the insect-life its destruction could be best effected. This requires a long and careful research by competent observers. I have myself written on two insect pests, the *Abraxas gropulasia* and the silver ermine moth, which attack the apple (*Tinea argentea*); and, given the mode of treatment, to diminish, if not to utterly destroy, these pests. Close research for several years is necessary to determine the steps necessary to be taken, mechanical and chemical. In the States of America, professional entomologists are paid by the State to report on noxious insects, and there are many valuable reports published on these subjects. I venture humbly to suggest that a committee might be advantageously appointed to communicate with the learned societies and men on the subject, with a view to obtain and disseminate sound information on noxious insects.—JOHN FREDERICK STANFORD.—*J. of Society of Arts.*

To show the extent to which the ravages of insects may affect the yield of a farm, and the consequent profit, we may take the instances selected by Mr. Murray, and a very notable one is that of the *Agromyza graminis*, a small fly which deposits its eggs under the skin of the leaf of the wheat plant, at its tip. The eggs speedily hatch, and the larvæ at once commence running downwards, eating the parenchyma and leaving nothing but the empty and dried skin. The result on a field of wheat can be readily imagined. The flow of nutriment to the ear is stayed by the deficient action of the leaves, and the consequence is that the yield is reduced by from 10 to 25 per cent. The attack of this insect is commonly denominated "blight," which is frequently said to be caused by drought; but "blight is a vague term in agricultural language, and may mean a great many different things, while its use shows clearly that the true cause of the effect is unknown.—*English Mechanic and World of Science.*

HAVING seen in one or two letters "From the Hills" that a good deal of mischief had been done to the tea trees by a small caterpillar, I have now much pleasure in sending three of the moths which have just come out of their chrysalis, and should like to know if you could find out what they are. I have been a good deal troubled with insect blight, and have been watching it pretty closely. The first was a small black bug and fly which came immediately after pruning; when the first shoots were about three inches long it was so bad that I had to let my flush run out of all bounds, as it was no use making an insect mixture; however, I waited as patiently as I could, and had the pleasure of seeing them all die, and the only thing left was a mass of dried

skins which were easily dusted off in plucking. They did not harm the growth, but seemed to keep creeping up to the point of the tip as it increased in size. The second, however, has been worse, because its voracity was enormous; it made itself a dwelling by drawing all the young leaves together with a web and then in the night time devouring everything. To those interested in tea and who at any time are troubled, for the first I would say let your flush run up; don't be afraid of losing leaf: if you lose that you gain good wood for pruning on next year, so it's an ill-wind, &c., and as I hear there are some given to hard plucking it may be a blessing to have such a blight at the beginning of the season. For the second make the women crush up the caterpillars' nests as they go along plucking, and it's wonderful how many are got rid of.

Remarks on a Disease affecting the Tea Plant called "Rœst" (Rust).

By Dr. C. Aleyboom.

Up to the present period the calamities met with in tea culture have not yet been made a topic of serious research, and though this culture has been several years in existence on the island of Java, the causes thereof are not known.

The severest losses suffered by the manufacturer are caused by the rust. Opinions differ as to what the rust may be.

Some will account for it by causes to be found in the ground or in the atmosphere.

By stating what has been done to oppose and prevent the disease during a period of ten years, and what experience has learnt, as to the causes, I hope to prove their opinion is not the just one.

To elucidate the following, it may be found of use to consider the qualities of the soil, made use of to plant tea shrubs.

The grounds are derivates from trachytes and analogous rocks, and are to be divided in two groups, *i.e.*, grounds containing humus, and red clay grounds. The ground containing humus is a mechanical mixture of humus, clay, and grains of sand; it has a black hue, sometimes to eight feet of depth; when heated it becomes red by oxide of iron, and smells of ammonia. There are varieties of these grounds due to the different proportions of the composing elements.

Usually, they are composed of mineral substances and 8 to 20 per cent. humus. They have the property to absorb moisture, and preserve it a long time even in the dry season. The old shrubs prosper on these grounds, and produce a rich foliage, but young plants fade and perish. As to the seeds, they do not develop, but rot: this may be caused by the moistness and coldness of the grounds, that are void of the humus, which originally covered them.

The clay grounds have a brown hue; they are most times composed of fine clay and 10 to 15 per cent. oxide of iron, with some proportion of sand.

These grounds are arid; during the rains they absorb a great quantity of water, but become dry again immediately afterwards to a depth from two to three feet, and also become very warm.

The tea shrubs do not thrive in these grounds; by heavy rains they produce tolerably well, but in dry seasons very little.

During a period of several years the rust reigned in the plantation, but only for the last four years has it attained to an alarming extent.

The shrubs in the grounds, containing humus, were always affected by the blight, which attacked first the leaves and best developed shrubs on the best parts of the grounds: this is also the case on the grounds fertilized by alluvium at the base of, or in the valleys between the hills. The shrubs on the red grounds at first are exempt from the blight, but they are attacked also when the fine leaves from other shrubs are consumed.

At first I sought the cause of the disease in the exhaustion of the grounds, and in the fading state of the shrubs. The grounds were void of humus, and the roots from the shrubs laid bare. The grounds were top-dressed with good earth, and the roots covered therewith.

The shrubs developed again, and produced good leaves, which were also consumed by the rust.

Experiments were made by the following means :—

A very fertile part of the plantation was dug to a depth of 1½ feet during all the year, so as to root out the weeds.

The shrubs developed very well, but the rust increased.

A portion of the same grounds was

treated in the following way:—

Between the rows of shrubs were digged furrows 1½ feet of depth and one foot broad, filled for two-third part with branches of sundry trees.

At first the result appeared to be good, the shrubs developed and produced better leaves; but in a period of six months the former bad state returned.

An attempt was made to drain the grounds. The pipes were laid to a depth varying from 2½ to 3 feet at a distance of 24 feet.

In the month of October the work was finished. At the end of three months the shrubs had attained a height of three feet, produced much and well-developed leaves, greater than before, but the success was ephemeral.

In the month of January 1872, the rust attacked the shrubs so extensively, as to cause them all to perish in a short time.

Nearly 2,000 sticks, besmeared with tar and *Oleum cornu cervi foetidum,* were put in, the shrubs surpassing them two feet in height; but no success was attained.

Tar put in the ground was found unsuccessful.

Manuring the grounds with green leaves and weeds, also with dung from the cattle, proved fruitless.

Hundreds of pounds of *Calcium sulfuratum* were brought on the grounds, hoping that the exhalation of fly-dragon-sulphur might relieve the disease: but the experiment was a failure.

To an extent of 100 bouws (one bouw= 72,000 square feet) the grounds were covered with fresh phosphates made on the spot.

The shrubs developed by it, but the rust did not diminish.

On a windless day I burned a great quantity of squibs between the shrubs, by which they were thoroughly fumigated. The leaves fell off, and the shrubs remained leafless till the falling in of the rains.

Also an attempt was made by fumigation with sulphur.

The effect was the same, but caused a disadvantage; the branches died to a height of one foot. By searching the cause thereof, I found that the branches perished by the influence of *sulphuric* acid.

A fumigation of the shrubs, with sundry sorts of woods and leaves, smelling very loathsome, when burning had no influence at all. During the period that the rust reigned only in parts of the plantation and was less intense, the pruning of the shrubs often arrested the blight. The shrubs were pruned so as to make them leafless, and the crop burnt. The shrubs developed good leaves and could be plucked three times before the rust intervened. In the latter years the rust was very intense, and pruning proved of no use.

In order to know how the rust may act on the leaves of potatoes, I planted them in parts of the plantation where the blight reigned.

The leaves were blackened and dried just the same as the tea leaves.

On searching I found the effect was the same, and that the blight had another cause than that of ruining potatoes in Europe By examining the leaves with the help of a microscope, I found that the soft parts of the leaves were ruined, but I did not observe any parasites or insects on the leaves.

I had the conviction that the cause of this blight was not to be found on the ground or in the atmosphere, especially as the best-developed shrub suffered most by it.

On visiting Mr. Band, my opinion as to the cause of the blight was strengthened, as he showed me leaves of fuschia plants, and on a visit to Mr. H. T. Coster on the plantation of Bolang. Although the gardens are there under quite different conditions with regard to the climate and grounds, the rust reigned the same.

Mr. Coster also supposed that the rust was caused by insects. We agreed to make a full research on the matter. I caught sundry insects and set them under a bell-glass with young shoots from tea shrubs put in water. By so doing, I saw the rust develop. Mr. Coster mentions five species of insects that cause the rust. I found but one species, but do not know the name. It is a black flying insect, half the size of a walangsangit, with a long beak.

When magnified, the wings and eyes are glittering in sundry hues of a rainbow. Set under a bell-glass, it is easy to observe how the insects work. During the day they are in repose; but at night very busy. They attack the underside of the leaf, put in the long beak, and remain a long time on the same spot. Some hours afterwards the leaf shows a brown puncture, that slowly turns to black on the very spot, where the insects have been feeding.

If the leaf is punctured closely, it becomes black and so dry that it can be pulverized by rubbing it between the fingers.

When magnified, the punctures show that the soft part from the leaf are sucked dry to the epidermis.

The fore-mentioned ruin of the foliage not only causes severe losses, but suffices to ruin a whole plantation when increasing several years. If the insects are few in number the loss is less severe; from the punctured leaves can be made tea; but when steadily increasing, all the crop is lost. The damage also would be less if the old and hard leaves only were consumed; but the insects attack the top leaves first, and afterwards the young and still tender leaves. When these are consumed the old leaves are attacked also; they become black and dry till falling off and leave the shrub leafless. In this condition it remains till the falling in of the rains. To prune the shrubs, when leafless, is of no use at all, and often proves hurtful to it. The shrubs make no shoots at all, for the insects, after having destroyed all the foliage, search the part of the twigs, where the juices are gathering to develop a bud, and by sucking the juices, thwart all development.

The consequences are fatal. By remaining leafless, the shrubs are exposed to the heat of the sun, by which the bark is whitened, and the wood becomes dry, which impedes the circulation of the juice. When brought to this sad condition two years successively, the branches are covered with mosses and die, after having been inactive a long time. The plant suffers severely. It produces no healthy shoots at all, and few bad developed leaves near to the ground.

If the rust is of an intense character a regular pluck becomes impossible. The best way is to pluck ripe and very young leaves at once. By so doing the loss is reduced as much as possible, for by not plucking the young leaves, the insects feed thereon, and the crop becomes very uncertain. The producing power of the shrubs also diminish. It is also fruitless to plant young shrubs, for they perish as soon as the top leaves are blackened. I know very little with regard to the manner of living of these insects; also as to their development. What I have observed, is as follows:—

The insects remain by day near streams and moist ground, and feed by night. In the plantation a few insects are found by day in the shrubs, which protect them from the sun by their rich foliage. In the ground, under the shrubs, they are not to be found. I remarked this in the gardens. The part of the plantation most injured by the rust is girt by sawahs (paddy grounds) and a river. From the year 1867 the sawahs surrounded the whole plantation, and the rust was very heavy. Cold and wet seasons are favourable to the development of the insect. After a fortnight, with heavy rains and low temperature, they begin to ravage the shrubs.

In the year 1868, on the 7th of January, the rust fell in so intensely as to destroy two-thirds of the crop: also on the 8th of February 1870, and on the 1st of February this year. On the said periods there fell heavy rains with a low temperature.—*Agri.-Hort. Society's Journal.*

Some planter friends showed us a few days ago what, so far as we are aware, is a new tea pest. This is a very diminutive insect, of a very light green color. His habitat is the underpart of the tea leaf, and his color is so nearly that of his place of abode that it is exceedingly difficult to find him, and when found, it is by no means easy to catch him; as he seems to be a very wide-awake little insect indeed, and of remarkably active habits. Examined with a low power microscope, this insect appears to have six very powerful legs, a flea-like body, very long, slender antennæ, and a large head, in proportion to the size of the body, furnished with very powerful jaws and large eyes. He appears to pierce the tender bark of the young flush as well as the midribs of the leaves, which, on examination under the magnifier, presented a cankered, ulcerous appearance. We saw several specimens of this pest on one tree, in company with several other kinds of blight insects. Several planters have noticed this insect on their trees. It is so small and active that it requires a good looking for before it can be discovered.—*Darjeeling News.*

Read a letter from Mr. Arthur Grote, acknowledging receipt of a specimen, submitted in July last, from the Editor of the *Indian Tea Gazette*, and described "as a new form of blight on tea bushes in Assam." Mr. Grote mentions that this is identified by Mr. F. Moore of the India Museum as "a species of *Diapromorpha*, of which genus you sent home another species some 6 or 7 years back. I cannot refer to the proceedings at this moment, but I think Moore called the latter *T. melanopus*, and the beetle now sent is nearly allied to it." The following is an extract from the Proceedings of February 1873 of the communication from Mr. Moore alluded to by Mr. Grote:—"The insect, which your correspondent of the Moran Tea Co., Cachar, states attacks and destroys the young Pekoe shoots, is the

same species of beetle named *Diapromorpha melanopus* that caused so much damage on the Cossipore Tea Estate in 1869, as noticed in the Society's Proceedings for November of that year. The only remedy that is at all likely to prove successful is that of having the tea plants carefully and regularly looked over several times during the day, and all insects found upon the plants picked off and instantly killed by pressing them between the fingers. This operation should form a part of the regular daily work of the hands on the plantation.—*Indian Agri-Horticultural Society's Report.*

TEA BLIGHT OR TEA PESTS,—WHICH?

THE above question suggested itself on reading Mr. S. E. Peal's article in No. 8. Vol. I, of your Paper, headed "Blights"; and, although entertaining a very high opinion of Mr. Peal's abilities, yet I cannot agree with him in calling our various tea pests Blight, as the word, to me, appears to have a totally different meaning. Taking up a dictionary, I find blight defined as "a disease or pestilence incident to plants," which conveys exactly what I have always understood as the meaning of the word; and I cannot see how an insect or insects attacking tea can be called either a disease or a pestilence, although they may cause disease, and thereby blight a plant and be a pest. It, therefore, seems to me that the term "blight," as applied to those pests, bugs, beetles, mosquitos, borers, &c., is altogether incorrect, and should not be used, as being misleading, and I think the term Pest should be used instead.

"Blight" or "pest" however, we planters are under a debt of gratitude to Mr. Peal for his able article, and I for one thank him cordially for the information therein conveyed. While not presuming to compete with him as an authority, I claim the privilege of a careful observer to point out what I consider errors in Mr. Peal's paper. In a subsequent letter he took another correspondent to task for calling his No. 5 Pest a "mosquito:" now I am inclined to agree with that correspondent that mosquito is a much better term than bug; and taking Mr. Peal's own definition of bug—see article—I think it scarcely bears out his agreement or rather dictum; for, after close observation of many thousands of the so-called bugs, I find that they do not answer the description, as their wings are not hard at any point, and do not cross like an X as Mr. Peal describes. They are, when full grown, extremely like a mosquito, though rather larger; and I venture to say that the pest, whatever may be its scientific name, will be more generally known as the Mosquito Pest than as anything else.

As to the description of the insect, on the whole I think Mr. Peal's is very correct, but on a few points I think he errs; for instance, he says that, when very young, it is "of a pale green colour;" now I have examined many thousand specimens, and I have never found one of that colour yet: they are even from the very earliest stages, when little larger than the Red Spider, of a brownish colour, and never during any stage of their existence become of a green colour. From the great similarity in appearance, otherwise, between the young of the Mosquito Pest and the Tea aphis, I am inclined to think that Mr. Peal must have confounded the two. So, to be certain as to the identity of the insect in various stages, I enclosed some of the minute youngsters in bottles, fed them daily with fresh tea shoots, and watched them develop into the full-fledged mosquito. When very young they are difficult to see, and really can only be found by searching closely among the small Pekoe buds that have been punctured. The smaller the insect the smaller the bud it attacks; they are extremely like little spiders, are of a brownish red colour, and retain this colour until the wings are developed, when they become black, as described by Mr. Peal. The rapidity with which the wings are developed is something wonderful:—with one specimen which I had imprisoned for about seven no wings were visible; then, two little embryo ones like minute quills showed themselves; and after these had remained about three days, the full four wings were developed apparently at once: certainly, late one evening no wings were visible, only the little stumps of quills, and in the morning the four wings were fully developed, and the insect had changed from brown to black, the spidery look had quite disappeared, and our unwelcome pest, the mosquito, stood developed. Another, which I put into a bottle one evening as a three-quarter-grown spider, appeared in the morning with its wings—a full-blown mosquito. While in the spider's stage they are all alike, except in regard to size, but when fully developed two different kinds appear,—one a slim, delicate sort of

fellow all black, the other with an orange hump between his shoulders, and with a dirty white abdomen. The former I take to be the male, and the latter the female: certainly, the black one appears always to keep the same size, after he has once got his wings; but the other gets very much enlarged about the abdomen, and I believe lays either eggs or young ones. I have searched oft and carefully, but as yet have discovered no eggs, and I have come to the conclusion that the young are deposited on the tea shoot, and at once set to destroy it.

The two anterior wings are not hard at any point, but are smaller at the point of insertion: they are in shape somewhat like a lawn-tennis bat, and when closed the bladder of one overlies the other, but they do not cross: all four wings are transparent, both when observed with the naked eye and through a magnifying glass. So much for appearance: now for the damage they do. This is simply awful, and is so bad, that if a garden got badly infested, I could quite understand half the estimated outturn being lost. As to a cure, Mr. Peal gives us little comfort. I quite agree with him that shade encourages the pest, but in weather, such as we have had this season, with either constant rain or cloud, no tree shade is needed, and the pest developes in the open. In Cachar, the Heron method of burning the trees has been tried, but I do think that the remedy is almost worse than the disease After long observation I found that I could catch without much trouble a large number of the pests in all the different stages, and after a while I put on a batch of women, under an experienced sirdar, to whom I had previously shewn the mosquito in all its forms, to catch all the insects they could, and pluck off all the punctured leaves and buds; this latter is necessary, as the injury done to the leaves by the insect has some poisonous influence on the shoots, and they blacken and die off, effectually stopping any further flushes for a considerable time. Hopeless as the work appeared at first, yet after the women once got into the way of it, I found that they could catch about an average of 60 to 100 insects per diem, and this sufficed to clear about 55 acres of tea in a week. Of course once going over will not be sufficient, as a number of the more minute youngsters will be left, and these will have to be searched for afterwards; but even one clearing has been of immense benefit. Any one whose garden is troubled with the pest, and who has not yet discovered the insect need only look carefully at any bush any of the leaves of which appear to have been lately punctured (as may be recognised by the greenish brown color of the punctures), and he will almost certainly find either the mosquito or its young. If only the larger of the young leaves are punctured, then the insect is full grown or nearly so; but if the minute pekoe tips, or buds just coming out, are attacked, then look for the pest under the form of a minute brownish red spider. To any one whose garden is attacked by this pest, in however slight a degree, I would say—set to at once and clear your garden of it, for if not exterminated at once, it will assuredly increase, and sooner or later will cause loss and trouble, besides possibly spreading the pest to other gardens perhaps.

Have any of your correspondents, whose gardens are troubled with Red Spider, tried plucking off *all* the affected leaves and destroying them? I have, and found it effective. The distinguishing mark of the mosquito pest is the *drumstick* standing erect between the shoulders.

A CORRESPONDENT sends the following memo. on the subject of Blight, the result, he says, of considerable experience by a practical man, on a badly blighted garden:—

"Split dry bamboos, make into convenient size bundles, set fire to same, and apply in the following manner:—One coolie at either side of the bush to hold the lighted bamboos or torch underneath, and shake about so as to disturb the insect, but at the same time not to injure the leaves or bushes; another coolie to hold a torch over the bush, which will be found to singe the insect in its endeavour to escape; every blighted leaf to be carefully plucked immediately after, and what is not fit for manufacture, to be burned or otherwise destroyed; and should this course not prove quite effective the first time, the blighted bushes might be gone over again in a similar manner."

Having requested one of our managers on a blight-affected garden in Cachar to carry out this plan to the letter, we have the following from him, dated Cachar, 5th November 1878:—

"I had the piece of tea affected carefully gone over with blazing bamboos, and the following day I had every leaf that was in the least marked by blight carefully plucked as directed. I found that for nearly six weeks there was little or no appearance of blight, but after that it made its appearance again, and is now

nearly as bad as ever. I feel certain that if the plan were carefully carried out, and commenced when blight makes its appearance on small patches of tea, that a great deal could be done in the way of checking blight."

I HAVE been troubled a great deal by a little insect of the Ladybird tribe, bright red on top and black underneath; it scrapes among the shoot underneath the Pekoe tip, causing the latter to turn black and drop down, never completely severed, but completely spoiled. I have had thousands of bushes damaged by this insect, and find it pay "hand over fist" to give the coolies so much for catching the little pests, say a pice for fifty. By so doing I have succeeded in destroying as many as 20,000 in the day. I will forward you a few specimens to look at; they are really as bad as the worst enemies of the tea plant in my humble opinion.

ON reading the able article "Tea Blight" I was struck by my surmises that lime would check that pest. Darjeeling Planter will find there is no improvement in the flush following the lime; but if after the application a hoeing has been given and rain falls, then the second flush after the liming will decidedly be stronger. Heavy liming. I opine, will check growth, but not so if done moderately. The proper time to lime is just before a shower, whereas if it is done on a fair day, the lime cannot spread, a deal drops off, and the operation is not so successful. Tea-house ash, sifted, could be mixed with lime to make it go further. Drought brings on the pest which the first heavy shower washes off, but they come back again; the lime kills them, as will eventually be proved.

IN your issue for January the 1st, I see an article on "Mosquito Blight," and am rather uncertain as to what insect you call the "Mosquito."

As it is important that as few names as possible should be attached to each insect pest, I would suggest the desirability of settling whether this same "Mosquito" is not really the "Tea Bug," already so well known as "*Hilopeltis theovora.*"

If such it is, you will at once see that the alarm due to a "new blight" is needless, and the last para. on page 30 hardly applies: we have real pests enough without adding fictions; some should be sent to the Curator, Indian Museum, to identify. The "Tea Bug" can be known by a small spine on the back like a *minute drumstick.* It has a proboscis and no jaws, six legs and two long antennæ; when young and wingless, is under quarter of an inch long and tea liquor color, turning dark and black, with white belly, when grown and wings developed.

It is much like a mosquito in size and blight.

If not "Tea Bug," the so-called Mosquito may be the "Tea aphis" described in one of the notes on Blights I sent you.

As a name, the term "Mosquito" is misleading, see last para., p. 30.

S. E. P.

IN yours of the 19th ultimo an "Observer" writes about catching the Mosquito Blight (or Pest) by hand. The plan has, to my knowledge, been successfully carried on in Assam for the last five years.

I have also seen it attempted by some who have failed, but that was owing either to their not commencing in time, or to their not putting on sufficient people to cope with the insects, which are most prolific breeders. The cold weather puts a stop to their nonsense; chiefly, I think, through stopping their supply of food, which consists of sappy young leaves; but they commence their old tricks again early in spring, unless they have been completely exterminated by heavy pruning and clean hoeing.

I FIND that neither you nor your correspondents have taken any notice of one of the greatest tea blights, the most destructive and difficult to exterminate—the white ants. I had a belief that these insects only attack old gardens which are not kept clean, and where dead wood is allowed to rot; but it is not so. I see that the white ants will infest young and old gardens equally, though every care be taken to keep them free from all decayed timber. Our garden is only 2½ years old, and the best block is suffering from the depredations of the white ants. It is heart-rending to see a young thriving bush, which showed no symptoms of decay in the evening, lying prostrate on the ground next morning, with a hole in the trunk an inch long and ¼ inch in diameter. I consulted several of my brother planters, old and experienced, in Chittagong, and they all advised me to keep up constant hoeing, but it had no effect. I next tried kerosine oil, and painted every bush in the block with a brush, but it was of no avail.

I have carefully studied all the essays

on tea; they do not suggest anything more.

Mr. Shipp says: "Should the young seedlings be attacked by caterpillars, ants, or other insects, they may be speedily exterminated by turning a few domestic fowls into the nursery, as, from close observation, it has been found they do no injury to the growing plants." This can only be done in the nursery, but not in a large block; and, moreover, it is difficult to find out the place infested till the injury is complete.

MOSQUITO BLIGHT.

MANY promising estates this year have been short 25 and 30 per cent. of their outturn from this blight, and we believe, if estimated on the whole planted area, the crop of this season has been reduced fully 8 to 10 per cent.; but even if 5 per cent. measured the loss, it would represent an enormous sum of money.

These insect pests, it is known, are increasing in their destructive effects on the tea plants of Assam and Cachar. It has been argued that their presence is the result of exhausted soil; and where young estates, opened out on rich virgin soil, have suffered, a cause has been sought for in the seed from which the plant was raised; impoverishment of the soil is the argument, and doubtless the conscientious belief of many able men, whilst others seek immunity by a more careful selection of seed. A remedy is also sought in extra cultivation and in using manure; still the pest is present, and we know many promising estates where, though soil, seed, and position have been all that could be desired, and labor superabundant, yet nevertheless the garden has been almost black, and the crop of the season ruined by this dreaded mosquito,—devouring wood as well as leaves, and sucking out the very core of the young stem.

The planters as a class hold varied views regarding these pests. Some hold that the mosquito cannot be destroyed until the surrounding country is thoroughly drained; and consequently they see no remedy: others dread the proximity to forest lands; whilst others argue that mosquitos migrate, and are capable of flying in a brief period a distance in search of food. But these all, earnest men, appear to lose sight of the fact that the mosquito is a pest that was unknown until within the past few years, and that it is now becoming more destructive every season.

THE "Tea Bug" described by our correspondent S. E. P., in his letter of 30th January, it is possible may be found to be the *Hilopeltis theovora* described by him as resembling a mosquito.

Various theories are entertained as to its origin, but no concerted plan as to what had best be done to effect its removal has been adopted. On some estates, fire has been applied, and in others the knife, with extreme severity; whilst others have trusted to chemical applications; others, again, have relied on high cultivation; whilst many have despaired of a remedy, and have left nature to work its own cure.

Many promising estates were mulct 20 per cent. and 25 per cent. of their crop last year through this pest.

This blight in Cachar and Sylhet is, we are informed, in every respect a mosquito of the ordinary type: it abounds more on lands that border on bheels and swamps, stagnant water and rank grass being apparently conducive and essential to its existence. We know there are

localities where it does not exist,—for instance, lands bordering on clear running streams, and that plants of the Cachar Indigenous and good Hybrid varieties are less subject to be blighted by it than poorer classes of Hybrid and China.

We are advised that the insect, when it alights on the tea leaf, is of the ordinary greyish colour; but as it feeds, it assumes a dark greenish tint, corresponding to the sap which it has extracted, and furthermore, if it lodges on your hand or face it inflicts the same smarting and irritable sting as the ordinary mosquito.

The history of the insect is of course a very interesting and essential feature in forming plans for its extinction. We know how varied are the opinions of those who have suffered losses from this insect pest; that it has been most destructive there can be no doubt, and worse still it is still a growing evil, for which, at present, we know of no remedy.

THE immense amount of damage sustained by several large concerns during the past season from the ravages of the "bug," or as some call it "mosquito," makes it a matter of the first importance to discover a remedy which can be applied in a practical manner.

No fumigating, or sponging, or syringing of leaves with any substance or liquid whatever, which might answer the purpose in a conservatory, would be a practicable remedy in a tea garden.

We should therefore do what we can to ascertain if another shrub or tree exists in the jungle, to which these pests would incline in preference to the tea bush, their taste for which is now exhibited in such a recklessly ruinous manner. Such a shrub or tree, if found, would at once deliver us from our enemies, as it could be planted amongst the tea as thickly as would be necessary, and would require no additional labor in cultivating it.

It is almost certain that no manure, or anything applied to the roots of the bushes as manure, would have any deterrent effect on the blight, as the "bugs" suck the juice of the young stems and leaves; anything therefore that would so affect the sap as to alter its natural taste and cause the rejection of it as food by the "bug," would also alter the taste of the tea manufactured, and most probably prove a poison.

Some things seem to have been forgotten by writers on this subject. Tea has been planted for the last fifteen years in almost every soil. Swamps may be planted out if sufficient fall is found to enable them to be drained. But on what soils are those gardens that are most affected by the "bug"? Why are the oldest gardens in Assam practically exempt from it, while new gardens in some districts, before half the season is over, look as if they have passed through a fiery furnace? Is there any affinity between the soil and the habitat of the "bug"?

These are matters worthy of attention as it is well known that this blight is particularly fond of the most succulent shoots of the most healthy bushes in the garden it chooses to visit.

I HAVE noticed—anent Mosquito Blight—

1st.—That it does not show itself in the cold weather.

2nd.—It appears first on the little buds between the leaves and stems where the new shoots come from.

3rd.—It develops with the young leaves in spring, and increases with them.

4th.—It appears yearly on the same plots.

5th.—It sticks more to some plots than to others that are treated the same way, and are on similar sites.

6th.—It is worst under tree shade.

7th.—Heavy rain affects it somewhat, and hot sunny weather helps it.

8th.—It disappears to a great extent with heavy pruning, and is worst on light pruned patches.

9th.—It disappears to a great extent if the jungle be allowed to grow over the bushes.

10th.—Nothing but cutting the bushes down so as not to leave an *eye* effects a radical cure.

11th.—I have never noticed it on grass land.

12th.—It is worst on high land.

13th.—It attacks the silkworm.

14th.—It is very fond of the *Pan* plant.

15th.—The Assamese call it 'Hoohonee.'

16th.—It breeds all through the rains.

17th.—You generally see two little ones together.

18th.—The insects at all stages are easily caught with the hand.

19th.—Cultivation alone is of no avail against it.

20th.—In plants that are badly attacked the pith of all the green shoots gets poisoned.

THE TEA GRUB.*

I MAY mention that this is no new pest; for I have seen any quantity of it for fully twelve years past. Probably, there is nothing that will kill tea trees quicker than this grub, if allowed to go on breeding without being checked.

On the first occasion I noticed this grub do serious damage was in a neighbour's garden in Mungledye. I might say my first introduction to it was when several hundreds of bushes had been killed, and many thousands attacked. I found, on talking the matter over, that in the previous year many trees were attacked, and some died. Nothing more was done to prevent the increase; however, the following year soon showed how they multiplied, and as I said before, the garden was overrun with them. All hands were called out, all work stopped, and these little cages or cocoons containing the grub were picked off, which is a very simple method. They are, I think, generally to be seen hard at work about April.

A careful man need never be afraid of them. Some years they are in greater quantities than others, but once in your garden you never lose them. By watching carefully they can be kept in check, and the only damage they will cause the planter is the loss of a few men's labor in the year. I had a very simple method of finding out where they were attacking. They invariably first begin on one tree in a spot, and take nearly all the leaves and bark off, or what few leaves are left are punctured to such an extent that they fall of. Whenever a tree is bare or looks sickly, let the manager at once proceed to see whether the tree has been attacked by grubs or not. If he finds it has, he will see many hanging on to their basket-house, and by looking into the neighbouring healthy trees, he will see them beginning their work of demolishing. Then, some boys or women should be put on to look thoroughly over the bushes, and take off all they can see, and burn them.

Further than this, with care, they never can go if looked after; damage they can and will do if allowed.

My native establishment were all instructed to examine any bush attacked, and report it to whoever was in charge. The mere fact of their eating the bark kills the limbs and leaves, and if allowed to go on, the tree soon follows, but not from their bite being poisonous.

If by any chance trees should have been attacked, and look dead in the upper part, the best plan is to cut the tree down to the ground, when it will spring up again, if there should be any vitality left in the roots; and by always doing this, you have a chance of saving the tree before all life is out of it.

When a tree has been well attacked, so as to be nearly abandoned, the stem and limbs show a light brown appearance.

The Assamese, for want of a name, call the grub as it is on the bushes "Batea banda puk," which means, the insect or grub that makes its house or cocoon.

RED SPIDER.

MR. SCHROTTKY'S theory, as regards the origin of Red Spider, and the means of its cure, have been so completely set aside as unsound, that it will serve no purpose to reproduce his paper, or the one in which we were able successfully to disprove his arguments.

The foregoing articles, correspondence, and selections throw much light on the subject, but we are still far from having a certain and effective remedy. It is to be hoped that the commission which was talked about a month or two ago will really be appointed, and will go exhaustively into the question not only of Red Spider, but of Insect Blights as affecting tea, generally.

* We have been favoured with this communication by Messrs. Balmer, Lawrie & Co. This refers to a grub mentioned in Messrs. Balmer, Lawrie & Co.'s Circular of 19th May.

It is by no means the case, as some have said, that Red Spider disappears altogether in the rains. It undoubtedly diminishes, which is probably owing to the eggs on the leaves and on the ground becoming to a great extent destroyed or addled by the damp. The bushes also, of course, get well washed. Thus necessarily there is temporary relief from the pest. But inasmuch as the eggs are laid in millions probably over a large piece of ground, there will always remain sufficient for a break of warm weather to hatch into life. And so the spider remains, to return anew in full force on the advent of heat, when it is most prevalent. It appears, in fact, during the rains, to be simply "scotched, not killed."

Mr. G. W. Christison, general manager of the Leebong Tea Co., and a high authority, says in his last yearly report to the Directors:—

The "Red Spider," referred to in last report, seemed rather to abate during the rains, but this was owing in a great measure to the nature of the pruning; it has by no means died out, on the contrary the plants are already again quite red on many parts of the plot. At the commencement of the rains the pest also appeared, and by July nearly the whole of those pieces had become very red. The evil increased instead of diminishing till the close of the rains, and even continued during the cold weather. It is difficult to apply any remedy over so wide an area. The treatment recommended by the best authorities at home, is syringing with lime water, and this has been resorted to pretty extensively last month, and apparently with good results.

We ourselves saw the part affected on the above estate last year, and closely examined the leaves with a microscope. The spider-web was found in lines over the upper surface, and dozens of broken egg-shells were discernible on each leaf, while the young were seen coming out of other shells, and the adult members were travelling to and fro with great rapidity. We overhauled many bushes, but as a rule found the blight on the upper surface of the leaf only.

The general impression seems to be that the pest was originally introduced in tea-seed from Assam. Some ten years ago it was hardly known in the Darjeeling district; but it has been increasing gradually for this period.

Mr. Schrottky has, in his paper on the so-called "Red Spider," reprinted in the *Indian Tea Gazette* of 16th August, definitely stated that this supposed parasite has been named by Mr. Rainey *Acarus theivora;* and, if this is so, (of which there cannot be any question), and if Mr. Rainey's classification is indisputable, it is at once proved that the Red Spider is not a spider at all, and has been going under an assumed name all this time. Thus, instead of calling him a spider, we had better at once give him his own proper denomination of "mite" *(Acarus)*; and thus bring him to his own proper level in the scale of organic life. Then, as to his specific name: Has it been satisfactorily proved that "*theivora*" is an appropriate title for this little mite? I am quite undecided myself on this question; but I cannot say that I ever noticed any decomposition or discoloration in the actual substance of the leaves of tea attacked by it, which could fairly be laid at the door of the "mite." If the tea leaf is actually the food of this animal, how is it used? Is the juice sucked from the inner part of the leaf, or is its surface eaten away, thus causing the reddish appearance of a garden attacked by the mite? I do not think the latter is the case; but have as yet submitted the injured leaves to

no microscopical examination; and certainly that the mites should extract the juice rather than eat the surface of the leaf is in accordance with the known habits of all the *Acaridæ*. But has it been proved that the juice is extracted from the leaf; or, are there any reasonable grounds for supposing that this is the case, except in the fact of the mites being an *Acarus?* If tea is really the food of the mite, how can we account for the older leaves only being attacked? Not being a chemist I cannot tell what difference there may be in the chemical composition of old and young tea-leaves; but it seems natural to suppose that the principal difference, as far as food is concerned, is the larger quantity of water in the young leaf; so we are to suppose that the mite prefers strong potations.

That the chemical composition of the leaves has anything to do with the presence of the "spider" I cannot believe, having seen the indiscriminate way in which gardens are attacked. High land and low land, flat and steep, stiff and sandy, are all equally liable to attack; and "Red Spider" may be seen at once upon the most healthy and the most unhealthy of plants. I have seen it in a nursery, made in low, almost marsh, land, when the plants were small, yellow and consumptive to the last degree; and I have seen it in a new garden with good soil, and where the plants were remarkably fine for their age, and even growing tolerably freely after being attacked by the blight. Surely, Mr. Schrottky does not mean to tell us that it is something abnormal in the chemical composition of the hop which causes the presence of *Aphis humuli* in the hop-gardens of Europe; or that were some possible change made by manuring, or other means in the chemical properties of the rose that *A. rosæ* would disappear. The cause of blight in the hop is the *Aphis*, and the cause of the blight, known as Red Spider in tea is, I feel certain, the *Acarus* and nothing else. Have blighted leaves and sound leaves from *the same plant* ever been submitted to a chemical analysis? I suspect that quite as much difference would be found between these as is shown in Mr. Schrottky's analyses of blighted and sound leaf from *the same gardens*.

I cannot conceive how Mr. Schrottky has been deceived into saying that "Red Spider" "will make its first appearance" only after five or six years of plucking. As I have said above, I have seen it on plants in a nursery, and on a certain eight-hundred acres, or a part of them rather, which have been more than once mentioned in the *Tea Gazette*. "Red Spider" made its appearance to a no inconsiderable extent before a leaf had been plucked. It is owing to these facts, more than anything else, that I am inclined to call in question Mr. Schrottky's theory about the Red Spider. I look upon his statement that, "after a garden has been plucked for five or six years, the Red Spider will first make its appearance," as one of his strongest arguments; but Mr. Schrottky had been greatly misled when he made such a statement at all; and deductions which are founded upon such false premises are certainly to be received with caution. Nor does it appear that "the larger the yield has been in any particular year, the greater in the following year will be the number of bushes attacked," is a statement fully borne out by facts: for instance, the estimates of 1876 were considerably above the actual outturn, according to the brokers' reports; yet this year "Red Spider" has appeared to a more alarming extent than probably in any previous one; and I have never yet heard it stated from actual experience that any amount of manure has the slightest effect in decreasing the extent of the blight, though I have heard many planters affirm that, in their particular case, heavy manuring was followed by no diminution of it.

I confess Mr. Schrottky's "sperm" theory troubles me not a little. What is the nature of this "sperm," and whither does it come? The *Acaridæ*

either lay eggs or bring forth living, though not fully developed young, and neither of these can fairly be called "sperms." Besides, Mr. Schrottky tells us distinctly that the "Red Spider" is "able to exist and *breed* only on leaves," and that "its instinct prevents it from leaving the spot where its sperms *came into existence.*" So the "sperm" would appear to be something distinct from the young brought forth by the mature *Acarus* on the plant, and is something "developed from sperms continually present in the atmospheric air." These "sperms" would appear to have a certain degree of volition, for "the Red Spider will not touch young growing leaves," and "does not travel from one leaf to another; but each bush and each leaf develops it independently of the others," and there will in a garden be always plants which are perfectly free from this "*insect*," which I suppose the "sperms" have sufficient instinct to avoid. Supposing that the tea plant was, through chemical agency, rendered unfit to be the food of the "mite," what would become of these "sperms?" Would they still continue to be present in the atmospheric air? Would they, under the altered circumstances, evolve into a different from of life? Are they palpable? I think we should be favoured with some more definite description of these "sperms" before we are asked to believe in them. It would be as reasonable to say that fish are derived from "sperms" constantly existing in atmospheric air, because a fish appears in a piece of water which hitherto was known to contain none, as to say "Red Spider" has such an origin. Where the explanation of the spread of animal life is so simple as it is in these lower forms, it seems a pity to resort to so poor an explanation as Mr. Schrottky has adopted.

SIR ADAM JELS PLACE.

RED SPIDER has been known to me in *detail* for many years, and the eggs seen, for two or three, though I did not say much about the latter, hoping to find a remedy; but I have lately shown the eggs to many; they are even so large that I once picked one up on the point of a needle *without* the microscope; and any ordinary microscope can show both spider and its eggs easily.

Did it not occur to Mr. Schrottky to try the microscope ere having recourse to the "*atmospheric sperm*" theory? What an amount of printing and excitement it would have saved! I enclose sketches of spider and eggs enlarged and coloured, which you can show to any sceptic, *re* the egg theory. The spider weaves a fine web over the leaf (upper) surface, and lives, eats, and lays its eggs under it; it is not a dense web. The blight in Java is not spider; it is (probably) either bug or aphis.

MY experience regarding Red Spider is that the only known cure at our command for this pest is, to allow the tea bushes, attacked or likely to be attacked by spider, to grow, without weakening them by picking off the young leaves, and to cultivate freely around the plants.

If planters were sentimental, and prepared to accept tormenting letters and possible dismissal from proprietors for short outturn of tea, they would stop picking the quarter flushes that come when the plants begin to look spidery or exhausted, in order to allow the bushes to recover their health.

ATTEMPTS to extirpate "Red Spider" have been rather extensively made in the district recently. Amongst the best and most practical is plucking or pruning off the affected leaves and burning them. It remains of course to be seen whether this "radical cure" will be successful.

KURSIONGITE seems to be at a loss for what will kill the Red Spider. I am rather inclined to think that manuring the plant will not do it, as Darjeelingite imagines. If planters would go to the expense and buy a few preparations that are used for this pest at home, and apply to the plants before getting too numerous, I am of opinion they would keep it down. I have not seen Red Spider so bad in the tea plant as in fruit trees in England. I have experienced a few years in fruit cultivation, and found nothing better to keep the spider down than using the syringe well, and I think if Kursiongite get two or three days' good heavy rain, he will find some of his Red Spider disappear; and it may be inferred that drought and not soil, &c., as Kursiongite is under the impression, is the cause, as

I have seen trees in all kinds of soil suffer badly with the pest. However, there are several preparations, used for this purpose at home, but I am not experienced enough to know if they would injure the flavour of tea if used.

CATTLE manure is a very good leaf producer, and is not so heating as oil-cake. Why do not planters lime their lands? It may prevent Red Spider. From the analysis of the tea leaves, it seems they take up 8½ of lime and 2½ per cent. of salt, or 11 per cent. in all. This done for 10 years on a garden yielding 400lbs. per acre, leaves very little in the soil: the sap is deficient in these two, the plant weaker, and therefore more liable to attack. *Proper* manures must be put,—not the miserable wishy-washy stuff which has been lying in a heap outside a "bustee," exposed for months to all the elements. Planters put on 10 tons per acre of this rubbish, and wonder there is not a change for the better. How charmingly does "Kursiongite" describe, in the issue of the *Gazette*, dated 18th July, the trouble taken to keep away Red Spider; but alas unsuccessfully! The tons of stable manure worked so "carefully into the soil" must have been got from a heap of dung lying outside the door, which must have had at least 90 inches of rain on it during the year. Can this ever be expected to do any good? There is a vast difference between protected and unprotected manures; this was tried at Inchture by Lord Kinnaird; when protected cowdung yielded over 25 per cent. more potatoes per acre than unprotected—and it will be the same with every crop to which it is applied. Up to date no proper experiments to prevent Red Spider by manuring have been tried.

THE Spider Blight commences at the east, and works away to the west; or rather, it commences in the Terai, and works itself up the hills, brought by the wind, etc.; for this reason, that in the Terai, there is more jungle than anywhere else, and from the paucity of labor it is not dug in. The soil is perhaps only once dug; therefore, it has little of the purifying action of the sun.

I quite agree that hard plucking, with little cultivation one year, tends next year to bring in Spider Blight, although the land may be highly manured. One of my best yielding gardens but up to last year not over-plucked, although it has yielded 11 maunds per acre two years ago, was this year affected by Spider Blight.

I must say that, when the disease was on, and perhaps half over, I thoroughly limed 18 acres: not by putting it at the foot of the trees, but by throwing it against the leaves side-ways with great force, so that the underpart of the leaves and the stems were well limed—rain falling, when it assisted to circulate the lime, and carry it to the roots of the trees—purifying, no doubt, the soil close to the roots, where salt, combined with this, was added in large quantities. The yield since has been very good. The stem of many fruit trees is white-washed in England; and the Chinese water the young tea plant to keep away insects.

RED SPIDER, as well as a small bug, has appeared more extensively than is usual this season in the three chief tea districts; the bug being chiefly noticeable in Assam, where it has been eating off the Pekoe tips in many gardens in a most ruthless manner. Experience has taught me that these two evils generally appear most frequently in low, damp or badly cultivated gardens.

IN your issue of the 20th ultimo, I notice a letter signed "Darjeelingite" as to the cause of Red Spider on certain gardens in the Kurseong district. As I am one of the sufferers from this pest, I can show a piece of cultivation that has had every care and attention shown it to try and guard against any kind of blight attacking it this year; but alas, a blight has attacked it, as well as Red Spider in abundance. This is a piece of cultivation that was pruned most carefully last cold weather, manured from stable refuse that had been rotting for years, and well worked into the soil round the roots of the plants at time of applying, and has been kept *perfectly clean* up to the present time.

It is a most strange fact that Red Spider may be in its very worst form on one plant, and the next plant to it perfectly free, with a magnificent flush on; so that I am of opinion the whole cause is to be found in the soil, sub-soil, and class of plant cultivated, with excessive moisture combined.

As to saying the spider never attacks *young* growing leaves it is ridiculous, for I could have shown acres of 5-year-old cultivation last month in splendid flush covered up to the very Pekoe bud, and I have the testimony of several neighbouring planters who can bear out my statement. What then can be done to rid

ourselves of this pest? Manure and high cultivation certainly will not do it in one year, nor will lime and wood-ash.

Mr. Schrottky suggests "that the principal direct cause to which the appearance of *Acarus theivora*, commonly called the Red Spider, is due, is an excess of mineral and organic acids in the sap of the plant;" and that this excess " is due to the continuous withdrawal of large quantities of the soluble alkalis, chiefly potash."

The thought that occurs to me is that, as on almost all factories it is the custom to throw the refuse ashes from the poeys or drying choolas amongst the plants round about the factory, there should at all events be no deficiency of potash in *these* plants, and consequently they should be as thoroughly protected against Red Spider as a vaccinated person is against small-pox.

I have witnessed the Red Spider blight in Assam on a very large acreage in the Nowgong district, and have watched its progress over the fields, and I have found the same cause which has brought it on there, attend it here. The pruning has a great deal to do with it; and if planters would delay their pruning for a few weeks longer after the flushing has stopped, they will find that the blight does not make its appearance so rapidly as usual, and yearly there will be a decrease in this sad drawback, and eventually it will go away altogether. Pruning immediately after the flushes weakens the trees materially; and, as in Assam, where there is a lull in the flushing for some months, the spider makes its appearance as soon as it finds a food supply ready and trees full of sap. The ground near the roots of the trees should be opened up as soon as possible after the pruning season, in order to receive such amount of atmospheric substance as they can during the drought months. The Bug blight is not of such consequence as the Red Spider one, but still the same cause brings it on, coupled with an unusual wet season. I have noticed, when the bug has attacked estates in Ceylon, an enemy amongst them in the shape of a green caterpillar; this insect destroys an amazing amount of bug, and one of them, which I placed in a box with tea terribly besmeared with bug, ate up almost every one during the night, doing no damage to the leaf. An application of sulphur-flowers over a nursery which had bug very badly, almost produced an instantaneous cure, and where large fields are attacked with Red Spider and bug in Assam and Darjeeling, I would strongly advise planters applying the fumes or smoke of burnt sulphur held under the leaves of the tea bushes, where the spider and bug generally take up their abode at times. The above view, along with digging near the roots of the tea bushes, will, I am confident, find a remedy, if not immediately, in a very short time.

I tried everything I could think of, and amongst the rest flowers of sulphur. Of this I put some into a muslin rag and shook it over the trees affected. I applied it about 10 p.m., and at 1 p.m. I could not find a single red spider alive on the trees it had been applied to.

There are two things I have noticed about Red Spider: these are, that they always appear first on the upper surface of the leaf, and that it is always the outside leaves on a bush that are attacked first.

About the middle of December 1876, a section of the garden was pruned, and about the end of February 1877 the adjoining field was pruned; the former was red with spider in 1877, while the latter was quite green, with the exception of a few bushes in the rows next to the spiders: I attribute the attack of these spiders to early plucking, as much as to early pruning. In 1878 both these patches were pruned about the end of January, and both were well covered with spider.

I think that as the garden cannot be always low pruned, and only a part of it late pruned, the bushes ought to be allowed to retain their first flush of a few stray shoots which make weak tea, but which planters gather to trim the bushes, as they say: and also that the *bhanji* leaves, which are plucked to make the bushes throw out new shoots quickly, should be allowed to remain as a natural basis for the second flush, which nature, assisted by the hoe, would soon produce and make the bushes stronger to yield more tea in the proper season, and to resist spider and other effects of the weather. I think too early and late manufacture will be given up, when we come to know more practically the nature of the tea plant. We even now see the folly of hoeing the soil off the hills, leaving the bushes on the slopes without soil for sustenance.

It seems unnatural that the bushes should be robbed of their young leaf before they have had time to recover from the pruning; and that the young leaf, by

which the plants should breathe when the juice is being sucked from the old leaf by the spider, should be taken off, leaving the plants without lungs.

Yet, while I advocate as late pruning as possible before the sap begins to rise in the bushes, and not to begin plucking leaf until the second flush is well advanced, so as to strengthen them to resist spider, &c., and not to pluck spidery bushes so long as the spiders leave the young leaf as lungs; I am aware that the mosquito blight-wallahs may advocate the opposite, because their troubles commence later on in the year than the spider. Mosquito blight has been cured by fire, properly applied, without damaging the bushes.

A CORRESPONDENT recommends shaking the bushes, but this is evidently impracticable and inefficient; for the shaking of the bushes, some have tried the plan of throwing clods. This of course may knock off the spider, but does the tree benefit by the rough treatment? We have seen syringing tried, and believe it to be the present best known remedy, for it is searching as well as gentle, and not so expensive or tedious (where water is available) as at first sight might appear.

WITH regard to Red Spider, I am inclined to believe that fresh manure is one of the chief causes of its propagation.

A short time ago, being under the necessity of manuring a small portion of bad tea, I told the garriwallahs to cart cowdung to it, and they, not knowing better, took the dung straight from the cow-house, and had carted away two or three loads before I saw and stopped them.

The rest of the piece was manured from last year's pits.

I now notice that Red Spider (an uncommon thing here) is appearing among the few bushes that received the pernicious stuff.

I may also mention as a further proof that I have noticed Red Spider earliest in the season, and worst in pieces of tea near cooly lines.

I HAVE tried 'Gishurst's Compound'; this certainly kills the spiders that are alive on the tree, but does not destroy the eggs, and after two or three days they are as thick as ever; 'kerosine oil' and 'carbolic acid' have about the same effect, but not so good as 'Gishurst's.' Plain water syringed well through the tree does as much good as anything I have tried; 'clay and cowdung' mixed well with water, and the plant well smothered with it, does good: but I think rain, rain, continuous rain, the very best remedy.

THE upper surface of the leaf attacked by Red Spider is strewn with the cast-off skins of the mites—a few entire, most broken and crumpled,—numbers of egg, and deserted yolk-bags firmly adhering excrementa, and filaments of the finest web stretched here and there, and occasionally spun in little masses. The ova deposited on the upper surface of the leaf, the favorite nest being evidently along either side of the centre stalk. All this space is fully occupied, but eggs are also to be found scattered without any order here and there over the remaining surface of the leaf. Occasionally a few may be seen on the underside, but rarely, and on none of the leaves I examined more than half a dozen, evidently stray ones. The little arachnoid indeed never seems much at his ease amongst the rough fibres of the inferior side of the leaf, as his free motion and progress over its uneven, ciliated surface is rendered somewhat difficult. It is clear that the little creatures are not evolved under the leaf, though it hardly seems a hazardous conjecture to suppose that they would, when free from the ovum and possessed of activity of limb, naturally seek the shelter which the underside would frequently afford them against the elements. When the ovum has recently been vacated, the entire yolk-bag may be seen, but the upper hemisphere, which at the exit of the larval spider is partially broken off, easily afterwards becomes entirely detached, and is blown away or otherwise shaken off the leaf, so that only the inferior hemisphere remains still firmly adhering.

The white mottles to be discerned on the superior surface of the foliage are principally of two kinds; the one in dense coarser patches is a fungoid growth; and the other, in appearance like a floury dust to the naked eye, and spread generally away from the divisory stalk more towards the marginal superfice, consists chiefly of the moulted skins of the little animals, intermingled also with dried and broken yolk-bags.

The *Ovum* is spherical pellucid, and very large as compared with the size of animal which deposits it. At its primary stage (I speak of the stage in which I was able to observe it, but it is highly probable that when quite recently deposited it may have a somewhat different

aspect) through the transparent outer membrane, a translucent, reddish brown, germinal vesicle, occupying fully one-third of the interior, may be discerned. It is possible though that what I denominate the *germinal vesicle* may already have attained the embryonic state. From the upper exterior surface of the enveloping membrane a fine clear white hyaline thread protrudes, generally of a length about equal to the diameter of the egg. This thread is of a structure as though consisting of the same viscous secretion as the yolk-bag, of which it is in reality an appendaged continuation, doubtless drawn out, as it were, as the egg leaves the ovipositor. Under a moderate magnifying power the dark reddish brown embryo may be observed gradually to extend its volume, whilst it loses intensity of colour, as it absorbs the food-yolk; the vitellus, which at first was clear and bright, becomes slightly turbid, and at length the whole ovum presents an almost uniform clouded fiery pink colour, more or less intensified here and there. The yolk-bag maintains its glassy aspect. Having reached this fiery pink stage, the egg is about ready to be hatched, and shortly the covering breaks on one side, the upper hemisphere is lifted, and a plump little creature of true spider-like appearance makes his exit, leaving the clear hyaline shell empty; and, after looking about a little and taking a few slow turns to test his translucent limbs, he makes off to survey his territory. This is the Red Spider in his infancy; but, as he attains a very high development in the ovum, he is much like his later perfect state, only that now he has not more than six legs, his color is much paler, and his body—very little smaller than the ovum from which he emerged—is rounder. His legs are transparent and almost colourless.

After a short period of activity, during which his abdomen, doubtless from the food he imbibes, is always becoming darker and darker in colour and somewhat more elongated in form, he settles upon one spot—now he is almost black, excepting his cephelo-thorax, and its appendages—his skin begins to dry and shrivel, and after a period of semi-torpor, he struggles and emerges from his first moult a perfect eight-legged spider. At first he looks tender, semi-transparent and fresh, excepting the black abdomen upon which the white bristles form a striking feature, but little by little his whole being becomes firmer and rougher, and his colour more uniformly red. The male may be distinguished from the female by his smaller size and more elongated abdomen.

TUPAC YUPANQUI.

I HAVE examined tea plants at all seasons, and even in the coldest part of the year have never failed to find the Red Spider, and healthy fertile looking eggs on some bushes. In the cold weather there are certainly very few, and these are comparatively sluggish and inactive: but as soon as the warm weather sets in they awaken to renewed activity and vigor in the propagation of their species.

Good and thorough cultivation has frequently given good results in lessening the spider, and it no doubt has lessened its evil effects; but cultivation in itself does not actually diminish the numbers of the arachnoid. It simply gives vigor to the bush, and thus enables it to withstand the weakening effects of the blight with less apparent detriment, just as a strong, healthy man might support drains upon his strength without showing fatigue, where a weak cachectic man would fail and give way.

As to the rain putting an end to the spider's ravages it undoubtedly does so for a time, probably by the simple mechanical process of either washing the spiders off the leaf, or destroying them *in situ*; but the eggs remain firmly adhering to the leaf, and are neither washed off nor destroyed; consequently, as soon as the rain has stopped, all these ova begin to furnish a new generation. The action of the rain has, besides this, the same favourable influence as cultivation, and in giving strength and growth to the bush, it assists in obliterating the injurious effects of the blight as well as attacking its source.

TUPAC YUPANQUI.

A PLANTER of extensive knowledge and long experience attributes the Red Spider to over-plucking, *i.e.*, plucking late in the year, and after the tea-yielding season proper is over. This, he says, tends to weaken the plant, which thus induces the spider to put in an appearance sooner or later, and the bush has then to be nursed or have the benefit of its young leaf until it recovers. This pushes the yielding season late into May, whereas steady plucking ought to take place in the middle of April. Our correspondent does not consider it a question of exhaustion of soil, but merely of exhaustion of plant alone, caused by too early plucking. The bush gets deprived of every leaf late in the year at the expense of the root of the plant.

As to gardens which have never been plucked, the writer inquires whether they consist of transplants, as these often show spider when put out among healthy bushes in ordinary plucking, and whether this is due to the shock the transplants receive, or to any injury the roots may have suffered. He says Red Spider attacks bushes weakened by this cause, and plants put in with extra care are less liable to show it, especially those put in a deeply-hoed, well-prepared nursery, as the roots will have a downward tendency, and not be so liable to injury in the course of keeping the nursery cleared. In conclusion, our correspondent maintains that if the plant is given fair, but not excessive, cultivation, and is not over-taxed towards the end of the year, it will, after its cold-weather rest, yield a better profit the following seasons at no expense to its life or health. While not deprecating manuring as altogether useless, the writer recommends its application in a liquid form, care at the same time being taken not to injure the root. Further, he says, do not manure with a view to get rid of the spider, as *considerate* treatment will do this. Bad cultivation, which means hardened ground, he adds, by depriving the bush of nourishment, is an incentive to the spider.—*I. D. News.*

EXPERIENCE has proved that the spider attacks young gardens as well as old, that highly manured and exhausted lands are equally obnoxious to the ravages of this pest, and that above 4,000 feet elevation the "Red Spider" finds himself out of his reckoning, and does little or no damage. It is known that in the hills a good steady fall of rain puts an end to his ravages but only for a time, for he is found as lively and ravenous as ever during a break in the rains—*Darjeeling News.*

RED SPIDER is, I believe, bred from eggs deposited by the spider of last year, and that they areb rought to maturity by heat, *i. e.*, in May and June, before the rains come on. *Sulphuric acid* would cause heat and hasten the maturity, and in the second place Red Spider attacks all ages of plants from 6 months old in nurseries to old plants. Mr. Schrottky is wrong in saying that it only attacks a garden after it has been plucked 5 or 6 times; this is not their habit. They attack all ages; and I must say, from what I have seen here, that the young plants on the new garden were both this and last year the worst. On the old garden, where the English manure was applied, it was very bad—every bush quite *red.*

A MIXTURE of one part of lime to two of wood-ashes sprinkled on the bushes, is recommended by an Assam tea planter as effectual in eradicating Red Spider.

SUMMARY OF OPINIONS REGARDING THE RED SPIDER.

COMPILED FROM OPINIONS OF LEADING CONTRIBUTORS TO THE "INDIAN TEA GAZETTE."

THE following summary is compiled from information furnished by leading planters of known ability and long experience; and here will be found gathered into one focus the information which at present exists on the subject, and the efficacy of such remedial measures as are known :—

1. It seems undoubted that certain atmospheric conditions, influenced by soil, and a lack of vigour in the plant, are conducive to the presence of Red Spider and to its retention. When we speak of atmospheric conditions, however, we by no means intend to refer to such conditions as apply to the presence of rust, smut, mildew, and mould; for it is in exceptionally dry seasons that the pest appears in most aggravated form, whereas the reverse is the case with the low forms of fungoid or atmospheric blight mentioned. We believe that the theory as to atmospheric sperms also has been completely disproved, and that the original advent of the spider is due to the like causes which create the advent in particular spots of

special pests. The insect was probably first introduced in tea seed, and its primary home would seem to have been Assam. Curiously enough, Red Spider is found to be more prevalent in the open, which is contrary to the previous belief; the argument having hitherto been that it was worse near jungly and wooded land.

Bright weather is favorable to its re-appearance, for the reason that the eggs, which have been washed into the earth during the rains, are hatched readily by the sun's warmth. Thus, in a garden which has been once attacked, the spread of the disease is found very marked in favorable conditions of the weather for the hatching of the eggs. This is less noticeable in the cold weather, when the blight, in fact, is almost absent: supporting the hypothesis that heat is a necessary continuing cause, as it is found to be in the case of the Red Spider of the English hot-houses.

2. It is to be regretted that the date of the original advent of Red Spider was not in the first instance particularly noted; but once present, it is found that its re-appearance occurs almost invariably towards the end of April and in May and June, the three hottest months of the year, when, as stated, the climatic conditions are most favorable for the hatching of eggs. On the Badamtam Garden, Darjeeling, it first appeared towards the end of May 1876. On the Company's other garden (Tukvar) it first appeared about same date in 1877; and at Badamtam it re-appeared a little earlier in the same season; and from that time till now that garden has never been entirely free from the pest. On Tukvar, last year, from end of July till middle of October, no live spiders or any ova were found upon the bushes, but with the return of the dry bright hot weather it re-appeared, and became worst on the parts most free from it formerly, and, strange to say, at the highest elevations—from 4,500 ft. to 5,200ft. On the parts most severely affected last rains—from 2,500ft. to 4,000ft.—a trace of spider or *ova* was hardly to be found.

3. There seems very little difference between the extent of the blight as regards closely-planted or wide-planted bushes, and this is accounted for by the theory that it is spread from plot to plot and garden to garden by coolies, in the same way as it may originally have been introduced by seed from district to district.

4. The blight having once appeared, there seems to be no *gradual* increase in its intensity in particular spots. It does its work promptly and effectually in a very short time; and removes rapidly to fresh fields and pastures new. The worst year was 1877, while in low pruned bushes the attack has been noted as less severe than in others.

5. The percentage of destruction in gardens once attacked by blight has reached often to one-half of the cultivation; and this, too, apparently without regard to late or early pruning.

6. The spider is found to follow, as a rule, no regular course in one direction, but to be eccentric in its appearance, which supports the theory that it is carried by coolies or by the wind from bush to bush; but where the soil, sub-soil and aspect are uniform, the action of spider is more uniform, and when the blight is at its very worst stage, an entire slope becomes black as if scorched with fire. During the hot dry weather in April and May or June till the setting in of the heavy rains, the blight in certain gardens in Darjeeling spreads with amazing rapidity—very much resembling the

progress of the potato disease on its advent at home.

7. It rarely happens that in an area once attacked, many patches escape free, but still it is found sufficiently so as to justify the theory that the spider does not travel, but is carried to adjacent places by coolies. If the atmospheric sperm theory were true, the whole of a garden of plants of like growth and vigour would stand to be simultaneously attacked. Yet we find that this is not so, but that healthy as well as weakly bushes are attacked in like manner, and that too irrespective of poverty or richness of the soil.

8. Further, the spider attacks good and bad, young and old bushes, drawing no distinction as regards age; and often the largest and most vigorous plants are found attacked the most, while on new nurseries, on well-manured new land, it has frequently been found most virulent.

9. We have several testimonies to the fact of nurseries being thus almost entirely blighted, and we have ourselves seen it to be the case often. On one estate in the Darjeeling district, in a nursery raised from seed imported from Assam the previous cold season, the seedlings were badly attacked with spider almost directly the hot weather commenced.

10. The spider is found almost invariably on the upper side of the leaf. It has occasionally been noticed on the underneath part, but only during very wet weather, when, doubtless, it retires there to escape the wash of the rain.

11. The eggs being extremely minute, it is found very difficult to discover them on the surface of the ground, but they are found freely on the upper surface of the leaves. Doubtless millions are washed into the soil by heavy rain, and many thus destroyed, but sufficient always remain to produce the re-appearance of the pest in conditions of weather favorable for its development.

12. As a rule, when bushes are attacked by spider blight, no other blight touches them, but aphis has been noticed, in Assam, at the same time, frequently.

13. But the appearance of aphis simultaneously with spider has not been found in any way to diminish the latter.

14. Syringing with thin mud and blue clay has been tried with success, the result following that the spider is imprisoned until rain falls and revives the bushes from their stagnant state, and then they throw out a brilliant green flush. Syringing with lime water has been found advantageous too, but the spider is found soon to re-appear. If lime water is used, to be at all effectual it must have plenty of strength and virtue. The Darjeeling lime is poor, and the experiments in this direction have not therefore met with much success there; yet this remedy is undoubtedly a good one, although preference may be given to a solution of mud or blue clay.

15. The application of dry lime has not generally proved successful, the first shower washing it off the leaves.

16. It seems established beyond doubt that spider blight is found present on bushes grown in well-manured land equally as in bushes in impoverished soil. Indeed on some gardens the very finest plots of plant on the best soils were the worst affected with spider. It has also been found, in Assam, that the blight is most prevalent on slow-growing bushes, high and low.

17. The weight of testimony on this point goes to show that the healthiest and most vigorous bushes

are as a rule the *first attacked.* Stagnant plants plucked too soon, or suffering from unfavourable weather, fall also early victims.

18. It has been noticed that in cases where plants were cut down almost to the ground, and the prunings burnt and buried in the form of ash, the pest appeared on the new growth. Heavy or light pruning seems to make little difference.

19. The evil is undoubtedly propagated by coolies and by insect agency. On either side of a well-frequented path the bushes have been found almost untouched, while a little way off, towards the centre of a plot, the blight has been found severe.

20. Little reliable information, unfortunately, can ever be obtained from even the most intelligent coolies or sirdars. Probably this might be otherwise if they were expressly cautioned and instructed, as far as possible, on the subject. Being all day long among the bushes, their opportunities for close observation are considerable, and it would be well to utilize them.

21. It is questioned by some whether heavy rain *does* wash off the spider, and it is argued that the disappearance of the spider in wet weather is attributable to the atmospheric condition being unfavourable, simply, to its existence. It always appears, however, on bushes once attacked, when bright, hot sunny weather sets in, or when drying east winds are prevalent.

22—23. Thus, the blight once present, the rains serve only as a temporary relief. The pest remains —greatly diminished, if not altogether actively absent, in the rains, dormant in the cold weather, and vigorous in the hot.

24. The spider may be said to attack almost exclusively the old leaves, but when the attack is very severe, and all the old leaves have been destroyed, the spiders run up the young flush as fast as it grows. But this is only where the attack has been serious. The hard leaves are preferred always.

25. At all elevations from 200 feet to between 1,700 and 5,300 feet. But in the Darjeeling district the worst appearance was from 2,500 to 4,000 feet. Below and above these ranges, the attack there has been only partial, though rather worse at 2,500 feet.

26. The quality of soil appears to make no difference whatever.

27. The spider lives, it has been ascertained, only three days. This observation applies to leaves which have been plucked and watched. Possibly on the living plant its term of life is longer.

28. It is established, by the observation of the majority of our correspondents, that bushes freed from spider during the rains, have an improved flush; probably owing to the cause that the sap, which had previously been prevented from circulating, gets vigour.

29. It is not proved that ants devour the spider, although we have heard it so stated.

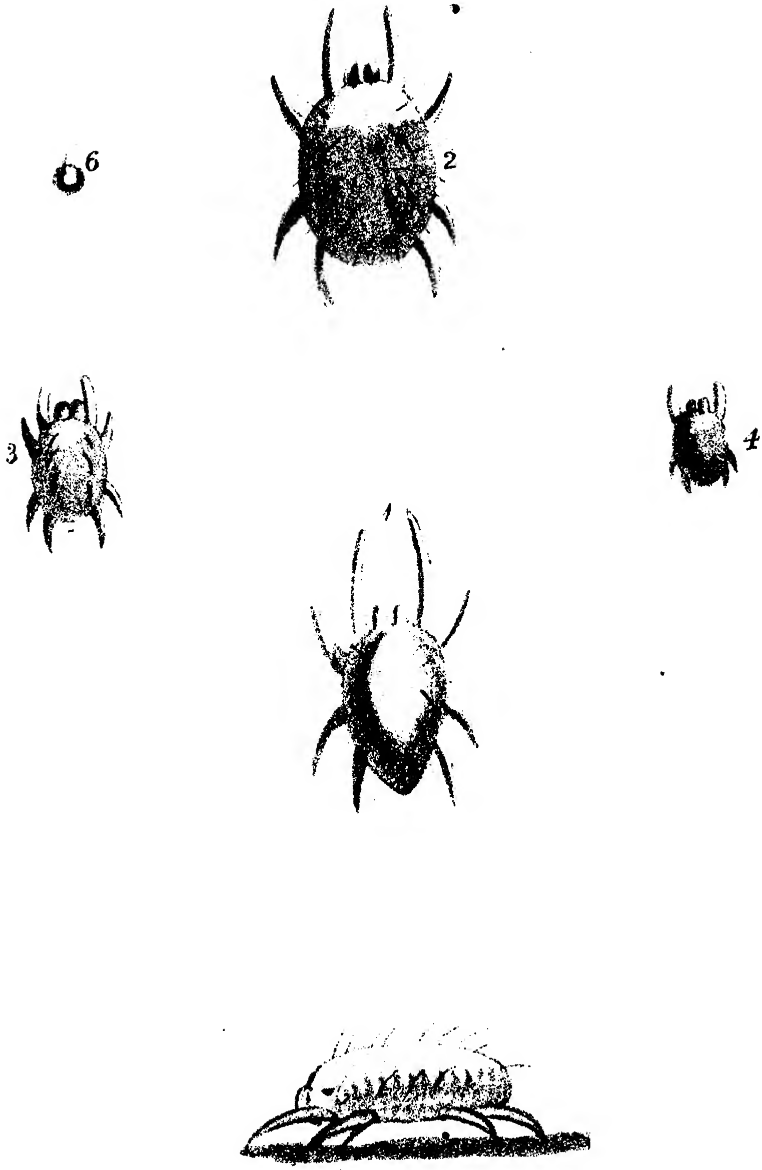
30. In Darjeeling, hybrids were found worse affected than the Chinese variety; but in cases of late pruning, elsewhere, the plants which, in a previous year, under early pruning, had been attacked, escaped.

31. The edges of the leaf are first attacked. These leaves when manufactured become red.

32. The theory that the cause of the disappearance of spider in the rains is due to the fact that it has by that time deposited its ova, and thence after dies out spontaneously, cannot be upheld, since the spider is present all the year round.

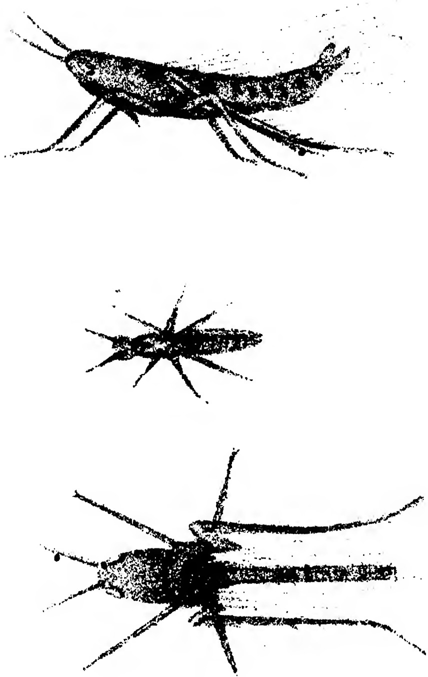
33. The presence of spider has been shown to be altogether independent of quality of soil.

RED SPIDER.

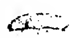


1 Female. 2 Male. 3 young. 4 [illegible]
6 legs. 5 egg & 6. 7 side view.

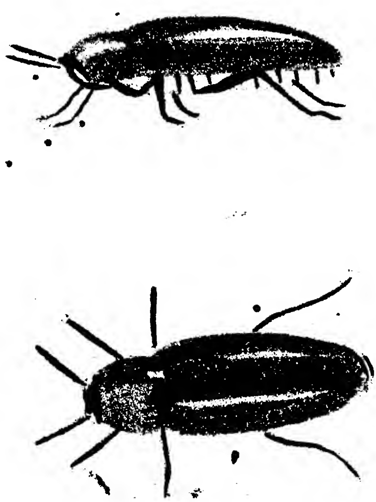
GREEN FLY OR APHIS.



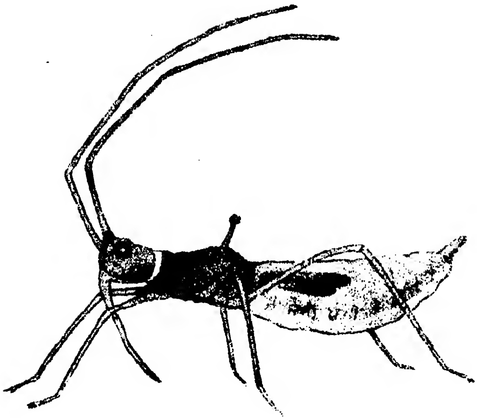
"ORANGE BEETLE"



nat size



TEA BUG.

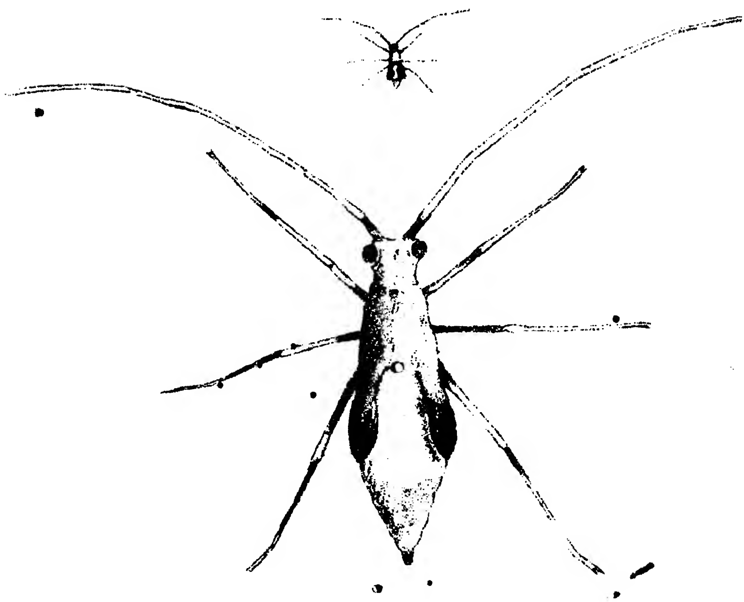


nat size

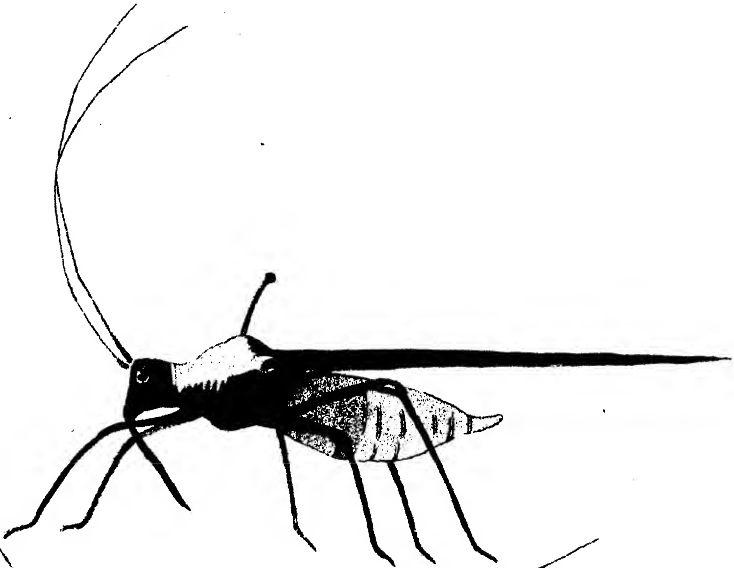
Enlarged side view

½ Grown

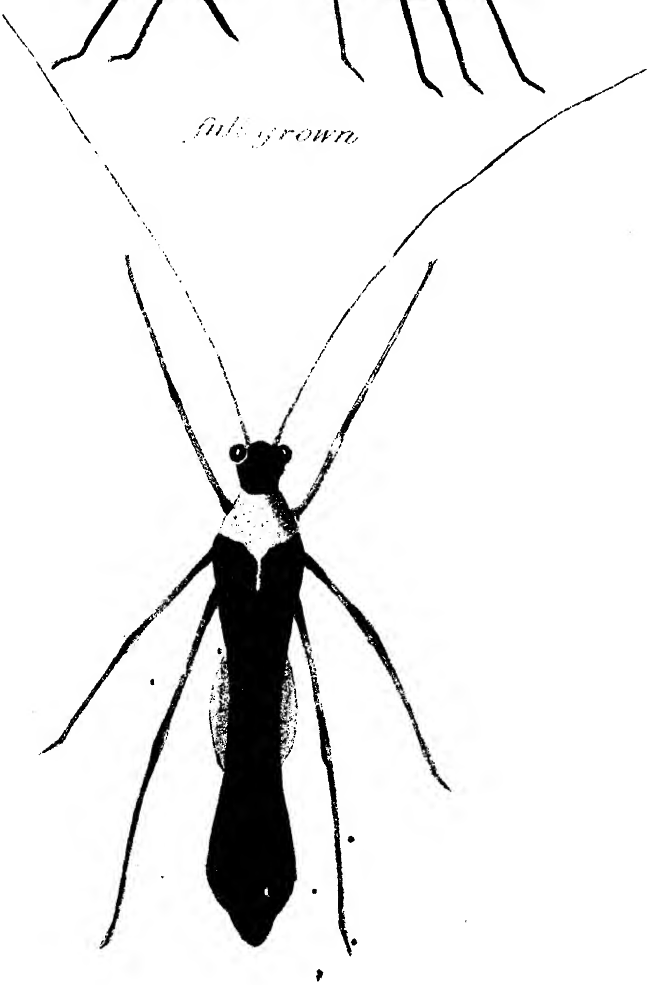
nat size ½ Grown.



(Back) Enlarged in this stage about 8 times.



full grown



TEA BUG.

Shoot pierced by immature insect

Shoot pierced by mature insect.

PART III.—TEA CULTIVATION AND MANUFACTURE.

TEA CULTIVATION.

By Sigma.

PART I.—PLANTING.

I.—Varieties of Plant.

A good deal of discussion has been provoked in order to discover whether all tea plants belong to the same or distinct species, and to what country they are indigenous? It will suffice, for all practical purposes, if we recognise the fact that there are two distinct varieties of tea plants, and that one is undoubtedly indigenous to India, while the other was first met with in China. From these circumstances one is called the "Assam," and the other the "China" plant.

The *Assam* plant is so called from its having been first discovered in the province of Assam, and subsequently in the neighbouring districts of Cachar, Sylhet, and Munipur. It is by far the nobler and more valuable variety. In the natural state it grows a forest tree, attaining a height of 25 or 30 feet in the dense luxuriant jungle of its native home. It is emphatically a tree and not a shrub. However, for agricultural purposes, the tree is dwarfed into a shrub, capable of being pruned and plucked without the assistance of ladders. The distinguishing features of this species are a single stem, a light ash-colored bark, and large yellowish green boldly-veined leaves of a satin texture. When in proper cultivation, this plant is a beautiful miniature tree, covered with luxuriant glossy foliage varying from light green to golden yellow shades at the tips of the branches. A fully-developed leaf approaches a foot in length, the stem about 8 inches in diameter, the circumference of the plant round the tips of the branches 20 feet, and the height 4 to 5 feet.

As is generally the case with plants of a superior species, the seeds are smaller and less prolific than those of the lower or China variety. The tea manufactured from the Assam plant is incomparably stronger, having more body and roughness than that made from the China leaf.

The pure Assam variety is called *indigenous.*

The *China* plant is an inferior species introduced into India, Java, and perhaps Japan, from the country which gives its name to this variety. This plant is essentially a shrub, or rather scrubby bush, most likely reduced to its present condition by neglect and poor soil; for it appears that in China only the poorest soils are planted with tea. (This circumstance unfortunately led the pioneers of Indian tea to conclude that poor soils and steep slopes were those best adapted for tea.) Its characteristics are many wiry stems, twigs rather than branches, numerous small, dark, glossy, scarcely perceptibly-veined leaves, seldom longer than 2 inches, and narrow in proportion. The seeds are larger and more numerous than in the Assam variety. The tea manufactured from China leaves, when of a very choice quality, seldom to be purchased out of Russia, has a peculiar delicacy of taste and aroma attributable more to the laborious and dainty manipulation of the Chinese tea-maker, than to any inherent virtue in the plant itself. Plants, whose age is to be counted by hundreds of years, are highly esteemed for their produce in China and Japan,—in this respect resembling the choice vines of Europe.

Owing no doubt to the variableness of its native climate, the China plant flourishes an evergreen, whether at an elevation of 7,000 feet above sea-level, or in tropical forests.

The hybrid, as its name indicates, is an intermixture of the two species of Assam and China. It is the most profitable plant in a commercial point of view, as it possesses the compactness and hardy nature of the China, together with the productiveness, and generally superior qualities, of the Assam plant. Naturally, its distinguishing features are similar to the parent variety it more nearly approaches. For industrial cultivation the indigenous is too delicate, and China too low. The hybrid is the *auream mediocriter*, or golden mean. For planting on hill gardens the hybrid should be a half Assam, half China variety. In some of the Darjeeling gardens an excellent dark green, glossy, large-leafed hybrid is to be found admirably adapted for hill plantations. Where a decent hybrid will not grow to pay, tea had better not be planted with any hope of profit.

For plantations in the hot plains of Bengal, the higher or more Assam the hybrid is, the better,—nothing lower than 60 per cent. Assam should be permitted.

However, as little or no scientific attention has been paid to the hybridation of the tea plant, and the very existence of hybrids is more a happy accident than the consummation of a well-planned attempt to introduce a more paying plant than either of the natural varieties, it is almost impossible to have ten acres of plant of a uniform class. The only practicable way to attain this desirable uniformity is to root out all low-class bushes, and supplant them with those of the desired standard. This is undoubtedly an expensive expedient, but one which would in the end well repay all the labor and money expended. To obviate such labor and expense in future, let all proprietors and managers have impressed upon them the value of having in every plantation a patch of plants, well apart from the degenerating influence of low Chinas and hybrids, of high class, even indigenous, cultivated for the express purpose of supplying a known class of seed for home use. Such a plan should especially be adopted by the Darjeeling, Terai, Chittagong, and other districts far removed from Assam,—at present the only source from which good seed can be obtained.

2.—Soil.

Soil, or the upper stratum of the earth's surface, is composed of humus or decayed vegetable matter, sand, clay, and mineral substances. Every plant requires a particular soil or peculiar combination of the above-mentioned constituents suited to the proper development of its roots, woody fibre, bark, leaves, flowers, fruits, and seed.

The tea plant being grown for its leaf, the soil must be suited for its healthy development. A chemical analysis of such leaf will show what elements are required in the soil to produce such foliage. However, if we consider the native soil of the Indian tea plant, we need not appeal to chemistry to learn that the soil must consist of a surface layer of rich vegetable mould on a bed of deep loam, such as only forest-covered lands can possess.

The vegetable mould will nourish the tender seedling, while its tap root will easily bore its way down

into the friable loam in search of mechanical support and vital moisture, which descends some feet below the surface during the dry season of the year.

Consequently, forest land is the best site for a tea plantation; jungle or scrub and grass land, when no other land is procurable. To attempt a plantation on land denuded of everything but stiff clay, by wash, or worked out into a sour, water-logged puddle, by cultivation, is simply handicapping the speculation beyond hope of success. It will not pay to manure heavily, and cut expensive drains before the plant can thrive and give a return. Let it be remarked once for all, that tea will only pay a decent percentage under favourable circumstances.

Having a block of land to select, the site of the actual plantation from, the prospecting planter must consider the question of soil, aspect, slope, and water-supply. The description of soil required has been already pointed out, and the nearest approach to it must be looked for.

The best *aspect* is between north-west and south-east, the more northerly the better. The opposite points of the compass have too great an exposure to sun and drying winds. Such aspects, on hill-sides especially, will invariably be the cause of innumerable vacancies, and perhaps of whole divisions of newly transplanted seedlings dying *en masse*. Except as a last resort, or unless counterbalanced by most important advantages of soil and slope, a southern or western slope should never be planted with tea. Utilise them by planting thickly with timber trees, and thus conserve moisture.

The most preferable slope is one just sufficient to drain the land of superfluous water. Too steep a gradient involves heavy terracing; too dead a level expensive drainage. If small undesirable patches occur in an otherwise suitable block of land, plant with appropriate descriptions of forest trees, instead of toiling and spending money, in trying to make the garden look a symmetrical sheet of tea. The game is not worth the candle.

A handy supply of perennial water is a great help in rearing nurseries, and keeping alive transplants in an unexpected break of dry, hot weather, especially when filling up vacancies.

A portable pump, with a canvas hose and a fine rose, would have saved many a thousand seedlings during a period of drought. The cost would not be worth considering with the result.

3.—Laying Out.

Method and arrangement are essential to the success of every undertaking, and perhaps in no branch of agriculture are they more necessary than in one, where one or two Europeans have to guide and check the work of hundreds of ignorant and generally perverse coolies.

In order to exercise a proper supervision over a plantation of any extent, especially in broken or hilly ground, it is absolutely necessary that (1) there be a series of blocks of plant; and (2) that there be decent bridle paths connecting them together.

A plantation should be divided into divisions and sections. The former to consist of 50 acres, and the latter of 10 acres, or as near to these dimensions as the nature of the ground will permit.

On the Himalayas, the hill side is usually cut up into strips by

water-courses, running from top to bottom in a pretty straight direction. On a *hill side* or sloping ground, having determined upon the acreage of the year's work, and selected the site of the future plantation, cut a level road, 8 feet wide, along the top of the intended plantation, At a distance of 220 yards lower down the hill, cut another of the same width and parallel to the top road, and a new and lower one every 220 yards. An acre being 220 yards long and 22 yards wide, or ten chains by one chain, the land enclosed between two of these parallel roads will give the length of an acre. At every 220 yards along the parallel roads place a stake. Connect these stakes by a road cut straight up and down hill. Thus, the entire plantation will be cut up into blocks 220 yards square, or 10 acres in extent, marked by roads. The number of sections between any two parallel roads will form a division. The above arrangement may seem impossible on many hill sides or broken country, but a little patience and determination will enable a very fair imitation of this chess-board system to be followed. Of course, the planter like the tailor, must cut his plantation according to his land. One thing, however, should never be lost sight of in laying out roads on a hill estate,—that the shortest line is the straightest, and will invariably be the one selected by the cooly, through jungle or tea if necessary, in spite of the most elaborate system of easy gradients. The planter, for his pony's comfort, can cut zig-zags (*goomties*), but let him start with the straight road as his base of operations, and leave it free for his coolies. Bridging hill streams is an expensive and generally useless labor. Merely level the bed with large slabs of stone so as to form a level causeway or ford without in an way obstructing the waterway.

For *flat lands* the foregoing plan is the most obvious and practicable, only that the roads should be 15 feet and 10 feet wide, to allow the passage of carts for collecting fuel, charcoal, manure, and even the leaf from the pluckers in the middle of the day. The want of roads leading to every section of a garden of tea is the cause of that portion being overlooked by the planter. The consequence is, bad cultivation and worse plucking, both of which throw back and sometimes ruin the bushes. Every planter of any experience knows that those portions of the garden adjacent to roads are invariably better treated by the coolies, for obvious reasons.

In selecting a site for a factory in hilly country, it must never be forgotten that a little forethought will make abundant water sooner available for driving all the machinery ever likely to be required in manufacture.

4.—Preparation of Land.

The truth of the old saying, "As you sow so you shall reap," cannot be better exemplified than in the results obtained from well and badly-prepared land under tea. The comparison of bushes grown on well-cleared, deeply-dug, thoroughly-exposed soil, with those grown on a merely scarified piece of land, will make the advantage of the dearer system over the cheaper manifest to the dullest comprehension.

Plantations are made with two objects. One, the profitable production of a valuable article of commerce; and the other, the deluding investors into buying a certain number of acres of plant. Accord-

ingly, the land is either properly prepared, or merely scratched and the seeds thrown in, or the seedlings stuck in anyhow—quality and quantity being the respective ends in view.

Having marked out the piece of land to be planted out by the level and sectional roads, cut down all undergrowth and saplings, if in forest land, and all the scrub if on jungly land. Each class of cooly has and understands his own way of clearing land best; let them follow it. Having cut down all the jungle immediately after the rains, let it dry thoroughly; and then on a windy, sunny day fire it in strips about 50 yards wide and the entire breadth of the clearing; collect all the charred debris and re-fire,—everything movable being burnt. *Grub up every stump by the roots* and burn them. This may seem a useless piece of expense; but if the land is to be deep dug, the soil must be rid of the net-work of roots round every stump. If the lines of tea bushes are to be regular and uniform, the obtruding stumps must be removed. The land being free of all jungle and roots, dig with the *khodalee* to a depth of at least 8 inches, and thus break the crust of the earth, and expose the myriads of roots. These should all be freed from earth, gathered in little heaps and burnt as the stumps and larger roots have been. If the roots are very numerous, as in grass land, after the first breaking up of the soil with the *khodalee,* dig all over again with the digging fork, or grope, with 14-inch tangs, and a spread of 10 inches—the finest agricultural implement in the world! The use of a *khodalee* for removing roots is not recommended; for being a *cutting* instrument, the grass roots are chopped up, and every little piece, as a rule, produces a clump of grass, while the fork *pierces* into the soil and loosens it, exposing long pieces of root, which can easily be gathered and burnt. The above method applies to flat or moderately sloping land; but if the land is steep, *it must first be terraced* and then dug up with *khodalee* and fork.

5.—Lining and Staking.

The surface of the land having been cleared of jungle, and the surface soil broken up and freed from roots, it becomes necessary to prepare the actual spot where the future bush will grow; but whether it will *thrive,* altogether depends on the way its home has been fitted for its reception. Taking a perfectly straight boundary road, or, in the absence of one, a line laid right through the plot as a guide, begin laying down parallel rows of stakes. To get the stakes in a line and equidistant, a thin rope, about 60 yards long, and knotted at equal distances, must be stretched by two men, each of whom with a rod, measures the same distance from the guiding road or line, and along this rope at each knot a stake is thrust in lightly. On a flat piece of land the stakes should present themselves in straight rows from every point of view; but on a slope, the lines should be parallel and equidistant, though, owing to inequality of the land, the individual stakes in each line may not correspond in position with those in the next. If the planter is particular, and can spare the time, he should personally lay out the stakes at either end of the rope; so that the coolies, having these stakes to guide them, can easily lay down the intermediate ones.

Each stake marks the exact spot where the future bush will stand. If the plants are to be pretty close in line, or anything under 3 feet apart, the easiest method will be to dig a trench, 18 inches deep and 12 inches wide, throwing the soil behind, *not out*, so that the line of stakes will fall right down the middle of the trench. The cooly should carefully replace the stake. The value of trenching land, and, if possible burying in neighbouring weeds, ashes, refuse, &c., is too well known to require comment.

However, if the plants are to stand well apart in the lines 4 feet or more, then it will perhaps be quicker and cheaper to dig holes with the stake for a centre; but the question can easily be settled in favor of the quicker or cheaper method by setting a gang of ten men to dig trenches, and another ten to dig holes, and seeing which gang covers more ground in a day's work.

The holes will require particular tools, but the trench the ordinary *khodalee;* which is another consideration in deciding for one plan or the other. I would strongly recommend trenches. In order to test the depth of the digging, whether in holes or trenches, each superintendent should be supplied with a stick, about the length of an ordinary walking stick, but tapering from a nicely-rounded head to a sharp point. At 20 inches up from the sharp end, a hole should be cut, and a cross piece passed through. Thus, a man, walking down a trench or line of holes, pushes his stick into the newly dug soil, and, if his rod sinks in up to the cross piece, he is certain that a proper depth has been attained. An ordinary carpenter will make a dozen of these standards a day. A hard close-grained wood should be chosen, or the points will easily blunt and splinter. The heads should be nicely rounded to fit and not hurt the palm of the hand, as the stick requires to be used thousands of times daily.

On slopes, the lines of bushes should invariably run *across* and not up and down hill, unless wide planting is done on terraced land, when the lines should run perfectly straight up and down. On all slopes there must be *wash* or abrasion of surface soil, especially, if dug up, caused by rain water. If the bushes are planted pretty closely in line across a slope, thin roots and stems will naturally hinder a good deal of wash; while, if planted up and down hill, the space between the plants being deeper and more dug than in the lines, the rain water collecting will rush down and soon establish cleanly-washed gutters for itself. *This loss of soil every year means the certain ruin of the garden.*

When the trenches or holes have been dug, a cooly with a mallet should drive home the stakes firmly, as they are required to indicate the position, and thus protect the little seedlings for the first year at least.

The distances at which the bushes are to stand depend on the slope of the ground and the class of seed used. The *steeper* the slope the *closer* the plants should be in line, ranging from 2 to 4 feet apart as the slope decreases. An ordinary hybrid on fairly flat land will be found to answer best at 4 feet apart in the lines. A uniform distance, for all gradients of 4 feet between the lines, will allow room for fair cultivation and development in the bushes.

For high class hybrids the distances each way should be increased by a foot, light and air being as necessary to the healthy condition of a plant as to that of a human being. Plants should never be

placed so close together as to exclude either. Covering land thickly with tea bushes with the object of checking the growth of weeds about them will simply end in their checking and choking each other; for instead of healthy, well-developed bushes, the result will be that the ground will be covered with starvelings, which will give a grand promise in the first few years of their existence; but the weak-minded planter will soon enough discover that his greed has caused him to over-reach himself. No man with a grain of common sense would ever adopt *clump* or *hedge* planting. He would know better than to expect a few square inches of soil to nourish a tea *bush.* Let any one hankering after such folly look into the tangled scrub above ground and matwork of roots below ground an overgrown nursery degenerates into, and he will get a pretty correct idea of what his clump or hedge planting would come to in the third or fourth year!

6.—Sowing at Stake.

There are two methods of covering a tea garden with plants—one by which the seed is sown, and the other by which the seedlings are planted out in the fields. The former of these plans is known as *Sowing at Stake*, or *in situ*, the latter as *Transplanting.* Both plans have their advantages and disadvantages; but, as the former is inapplicable to the majority of tea districts, owing to excessive heat and drought in the spring and summer, no lengthy balancing of the *pros* and *cons* is necessary. It will suffice to state here what will be apparent when the two methods are fully explained; that sowing *in situ* is the quicker, simpler, and perhaps cheaper method, while transplanting is much slower, more risky, and undoubtedly cannot produce such fine young plants as sowing once and for all, and never disturbing the seedling by transplanting it from nursery to the field. However, as Nature has distinctly defined the limits within which each or both systems may be put in practice, the planter has only to learn which one is applicable.

It has been explained how the field is prepared, lined, and *staked*, and the expression "Sowing at Stake" easily explains itself to mean sowing seeds round about these stakes. The soil, to a distance of eight or nine inches round these stakes, having been already dug, either in trenches or holes, is loosened with a hand-fork, or *koorpie*, and finely pulverised to a depth of six inches, and the seed sown in this spot.

The seed, plucked as late as possible, about the beginning of November, is shelled or released from its outer capsule, similar to that of a walnut, and generally containing two or three seeds, by being thinly spread out in the factory verandah or in an open shed until the capsule splits, and allows the seeds to be disengaged by women or children. The common practice of spreading out the seed in the sun to split the capsules, is not a safe one; for, if the sun be allowed to more than split the capsule, it will injure the vitality of the seed by making the kernel oily and yellow.

Some of the most productive plant the writer has seen was raised from seed at stake; but the seeds were sown, capsule and all, exactly as plucked from the tree, at a depth of about five inches below ground. Of course the seeds were much longer germinating; but had

they been shelled, they would most undoubtedly have been destroyed by heat and drought. The experiment is certainly worth trying in such districts as Chittagong and the Doon.

On being shelled, the seed should immediately be carried off* in *covered* baskets, and sown either at stake or in the nursery bed. The usual practice is to put two or three seeds at each stake, so as to ensure one seedling at least. If all succeed, the one or two surplus ones can be lifted and transplanted elsewhere. In sowing seed, whether *in situ* or in nurseries, the greatest care must be taken to ensure the seed being placed in a *proper position*, that is, with the eye or scar, caused by detaching the seed from its capsule, and corresponding with the human navel, *pointing to one side.* The reason why this position alone is the proper one is, that the roots and stems of plants, whose seeds are dicotyledonous, have two cotyledons or lobes joined together at the eye, emerge from this eye into the ground, or upwards, at right angles to the seed. Consequently, if the eye is put facing exactly up or down instead of sideways, either the root or the stem, or very likely both, will have to curl quite round a semicircle to get into or out of the earth; and it stands to reason that a distorted root or stem cannot nourish properly, or grow into a symmetrical plant. Besides, if it is necessary to transplant the seedling, as from nursery beds, the curled root will infallibly be snapped, and the seedlings be completely ruined.

To ensure seeds being sown at proper distances and depths, the simplest method is to use a *dibble.* This instrument is made by mortising a flat piece of wood, three inches wide and two thick, and the required length, to allow of a row of pegs, three inches in diameter, tapering down, for four inches into a blunt point to be fixed by tenons and trenails at the proper distances, measuring from point to point. For example, a *dibble* to sow *in situ* with, must have two pegs, six inches from point to point, with a notch cut in the horizontal piece of wood exactly midway. If a handle is also mortised in and shaped like a spade handle, a coolie will place the notch touching the stake, and press the horizontal wood with his feet, like a spade or digging-fork is pushed into the ground; two holes will be formed, three inches on either side of the stake and about three inches deep. The wood of the pegs should be the hardest and closest grain procurable, and turned on a lathe. Such a *dibble* would cost ten or twelve annas. The seed having been properly placed, and not thrown anyhow into the *dibble*-hole, should be covered over with a handful of *vegetable mould,* scraped up from off the surface of forest land or from among the roots of wild plantain-trees. A handful of leaves or innocuous grass stems, placed over the sown spot and kept down with a clod or handful of earth, will complete a *perfect* operation. Let disbelievers only try how easy such a system of sowing seed really is, and think how eminently successful it *must be,* and they will, like the Bishop's scoffers, stay to pray—or rather, practise. The seed once sown must be left undisturbed until the weeds appear, and the seedlings are big enough not to be unnoticed or negligently pulled up by the women and children employed to weed them. Watering seed at stake is impracticable, except at enormous labour and cost: and irregularly-watered seed will surely fail.

7.—NURSERIES.

It has been shown that there are two methods of covering a tea-field with bushes; *viz., sowing at stake,* and *transplanting.* For the former, *seed* is required; for the latter operation, *seedlings:* and the beds in which these are raised, are naturally called nurseries.

It will readily be conceded that, according to rearing, future development takes place: therefore, get the best seed procurable, and rear fine seedlings and develop productive bushes. The first care of a planter when he has selected the locality and soil of his future plantation, is to elect proper sites for his nurseries; for nurseries he must have, whether he sows at stake, or transplants, to raise seedlings to supply the places of those seeds that do not germinate, or those plants that die and cause vacancies.

The essentials of a nursery-site are: (1) proximity to a perennial water-supply, (2) perfect drainage, (3) soil fair, but rather stiff than otherwise, (4) protection from drying winds, and (5) shade. Of course all these requisites can be artificially supplied to any site, but a little fore-thought and trouble will generally enable one to find a desirable piece of bottom land or hollow near some stream or marsh possessing all the above detailed advantages.

Nurseries must be made with the object of supplying two classes or sizes of seedlings: (1) little ones, six or seven inches high and as many months old; (2) large plants eighteen or twenty months old, and about as many inches high, when tapped for transplanting, to replace those seedlings that have died in the spring and summer following the first transplanting. The first description of nursery may be called a *supply,* and the second a *reserve,* one.

Some planters imagine that a piece of ground dug some six or eight inches deep, the clods broken, a few roots picked out, divided into beds, the seed spread out in a layer as thick as it will lie, and covered over with an inch or two of earth, is the entire art of making a nursery!

The plot of land selected should be cleared of jungle, (not clean-stemmed shady trees), burnt and stubbed; the side roots of the shade trees within eighteen inches of the surface should be chopped off close to the stems. The whole plot, which should be a regular figure, a square or oblong, should then be dug to a depth of eighteen inches, and every particle of jungle and grass-root removed, and the soil pulverized. Make a raised walk, three feet wide all round the plot, and lay out the space within in beds, five feet wide, with paths one foot wide between them; the earth of the path being excavated to a depth of six inches, and spread evenly over the beds. Each bed must be perfectly level, though the plot may and should have a slope enough for perfect drainage. Two lines should then be stretched along the length of each bed, six inches from the edges; and along these lines, slips of bamboo, eight or nine inches long, driven firmly in every six inches for a *supply,* and every nine or twelve inches for a *reserve,* nursery bed. These distances can be very easily marked by long strips of bamboo notched at regular intervals, laid along the lines. A long dibble-stick, without a handle, with pegs every three inches for *supply,* and nine or twelve inches for *reserve,* beds is then laid across the bed, the notches at either end of the stick corresponding with a pair of the bamboo pegs, and firmly pressed down with both feet by a coolie. In

each hole a coolie, from either path as far as he can stretch, will properly place a seed and fill up the holes. Thus the seedlings will stand, the *supply* ones six inches apart between the lines and three inches apart from one another, and the larger *reserve* ones will each stand nine or twelve inches apart both ways.

Too much shade should not be given the nurseries, as seedlings grown in darkness and damp will be weaklings, and will die in large numbers when planted out in the broad glare of day. If natural shade be not available, a littering of paddy-straw or cut grass, to be thinned to a minimum, is advisable. Another plan is to place grass *tatties*, running nearly east and west, down the paths, so as to intercept the rays of the sun during the greater part of the day. The practice in vogue in Chittagong, of building flat-topped, walled-in sheds over nurseries, is most objectionable.

The true object of shade should be to prevent too rapid evaporation of moisture. In addition to shade, it will be necessary to regularly water the beds, with garden watering pots, every week during dry weather.

Flooding nurseries is injurious before the seedlings are above ground: a liberal sprinkling is all that is necessary.

The plants in a nursery should begin to appear above ground about two months after the seed is sown. A bug, like a lady-bird, is very fond of gnawing round the green tops of five and six-inch high seedlings, causing them to droop and wither. New shoots developing from the bases of the lower leaves cause the seedlings to bush prematurely. These bugs should be picked off by women and children, and killed as soon as the first batch are seen. Crickets are a more serious pest, as they bite off the tender stems, and retire to their holes at night. It is impossible to catch them, and very laborious and slow work digging them out. The best plan is to flood the nursery and drown them.

It is not often that the planter has choice seed of his own growing, or can get his requirements supplied by his next-door neighbour. He is generally obliged to send a long way, into another district perhaps; and in the case of the Darjeeling, Kumaon, the Doars, Kangra, and Chittagong plantations, not to mention the Arracan, Madras, and Ceylon gardens, a month's journey or more for his seed. As the best seed, on the plantation itself where it has been grown, cannot be depended upon to yield much more than 80 per cent. of fine plant, it is clear that something should be done to avoid spending as much time, labour, and money, on non-germinating as on germinating seed. Therefore, a test should be instituted which could, in some measure at least, separate the one kind from the other. As seed alters in weight, according as it is good or bad, using these terms in the sense of germinative and non-germinative, so the test of *weight* must be employed. Accepting, for obvious reasons, the fact that good seed is *heavier* than bad seed, we can easily separate the light from the heavy ones by *plunging them all into water*, just as eggs are tested. Those that *sink* are good, those that *float* are doubtful, if not really worthless. Having tested the seed, skim off the light ones and re-soak them; those that sink have a chance of germinating, and can be put out in a *separate* nursery pretty thick, in drills, three inches apart, and nearly touching each other. The

good seed should then be examined, by cracking a score or two, to see if the kernels are much shrivelled. If they are found to fairly fill up the shell, and are nice and crisp when crushed, sow at once; but in case the kernels are shrivelled and yellowish, and rattle in the shell, they must be swelled and partially germinated previous to being sown in the nursery beds. Have a pit dug near the nursery, about three feet wide, one foot deep, and any reasonable length. Place the seed in layers, one seed thick, with alternate layers of earth, two inches thick, and water the entire mass liberally. In a few days the brown hard shell of the seed will have cracked on one side, showing an amber-colored streak of kernel. Such split or partially germinated seed must be separated from the mass and *immediately* sown, and the nursery beds watered, so as not to check the germination in the slightest degree; while the unsplit seed can be recovered and watered until all have split and been sown. However, this must not be attempted with seed for sowing at stake, as they cannot be watered as in a nursery, and are sure to be sucked dead by the dry earth into which they are sown.

As to the quantity of seed and area of nursery-bed needed for an acre of bushes, a few general hints must suffice to guide the planter to make his own calculations. The number of bushes in an acre, planted four feet from one another either way, is 2,722. To supply such a number, there must be raised about 3,000 seedlings in the nursery-bed. The seeds in a *supply* nursery being six inches apart one way, and three inches another, each seed takes eighteen square inches of room, and 3,000 would require a piece of ground, including space for paths and the unsown foot of the bed, one-hundred feet long and six feet wide. And taking a *maund* to contain about 18,000 good seeds, it would require one hundred by thirty-six feet for a *maund* of seed, and a nursery 216 by 100 feet for 100 acres of plant.

However, there should also be a *reserve* nursery made, say to supply an estimated failure of 10 per cent. of the seedlings transplanted. Consequently, according as the distances in a *reserve* nursery were six by six or nine by nine, or twelve by twelve inches, so 112 or 255 or 450 square feet of nursery would be needed for an acre of bushes.

8.—Transplanting.

Having raised a lot of vigorous seedlings, six to eight inches high, it will be necessary to remove them from the nursery-beds, where they would cramp and stunt one another, to their final home in the tea-fields as soon as the rains have saturated the ground. The holes or trenches, which have already been dug and staked out, will require to be hand-weeded, and the less-dug land between them lightly hoed over, so that the seedlings may have a fair start with the weeds, which will increase in vigour and numbers as the rains continue. The fields must all be freshly stirred and weeded just before the rains commence,—for a day lost in the transplanting season means a week's loss of growth to the seedling; and were the first six weeks of the rains to be lost, it would be tantamount to the loss of a year's growth. This estimate may at first sight seem overdrawn, but let any planter compare plants transplanted in June with those put out in August, six months after being

put out, that is, in February,—the June plants will be well-grown thriving little bushes, while the August plants will have hardly a new leaf, and a serious percentage of them will die in the ensuing summer. The causes of such different results are obvious. The seedling put out in June is a small one; consequently it was easily lifted out of the nursery, and was better transplanted in every way than the August one, which had a much longer tap-root, was most probably injured in being lifted, or was bent and altogether badly housed in its new abode. The June seedling sustained a gentler shock, and recovering, easily pushed its roots deep and wide during six months when the earth was easily penetrable; and these probably put out four or six new leaves, when the August one was newly transplanted and was trying hard not to die of the shock to its entire system. However, it manages to live, and just begins to push out its roots when the rains stop; the ground becomes hard and the weather becomes cold; and then good-bye to all growth, and a struggle for bare existence commences. Meanwhile the June seedling, now developed into quite a respectable little tree, manages to live very comfortably through winter and summer, being able to reach moisture with its longer tap-root.

However, to return to the business on hand,—*Transplanting*. The nursery having been equally saturated with the rest of the land to be planted out, and having been kept scrupulously weeded and the crust open for the past months, a trench is dug at the end of a bed, about six or eight inches wide, and two inches deeper than the longest tap-root; a long four-pronged fork, fourteen inches tongs with a breadth of ten inches, is pushed straight in, right in the middle of the space between the first and second line of seedlings, and when deep enough, pushed forward towards the trench, when a clod, containing three or four seedlings, topples into the trench, but is just saved by a coolie who picks it up, divides the clod equally, and, gently squeezing the rather stiff clay, raises each plant into a cone, deposits it carefully in large shallow baskets, with all the balls of earth inside, and the little plants in a fringe all round the edge. The forker keeps on row after row in regular order, never treading on the plants, but standing in the side path and disengaging half the row from one path and half from the other. As soon as a basket of plants is collected, it must be immediately carried off to the transplanters, who, *koorpte* in hand, make holes large enough to admit the ball of earth round the plants, which being placed upright, the earth is replaced and firmly pressed down all round. Care should be taken not to imbed the plants right up to the collar, as the earth is sure to sink, and the plant will be buried too deep by the end of the rains.

It will be seen from the above, that, if a plant is properly lifted out of the nursery, with a fair amount of earth round it, but little care will be needed to transplant it properly; but it often happens, that the nursery having been badly made, and the seedlings carelessly lifted, they are received by the transplanter without any earth round about the roots. In fact some planters send the plants tied up in bundles like bunches of carrots, and trust them to the tender mercies of the transplanter, to be stuck into badly-dug land anyhow.

If it should happen that the seedlings are bare of earth round their roots, the transplanter should dig his

koorpie into the earth; and, working it backwards and forwards, make a wedge-shaped opening. Into this the plant should be carefully introduced, with the tap-root as straight as an arrow, and the earth firmly pushed back into position. A tea plant will stand a good deal of ill-treatment, yet there are limits to its endurance. If possible, transplanting should be carried out under constant European supervision, and, in default, the most careful, though slow and plodding, native on the estate should superintend and be held solely responsible. Remember, no after-care will compensate for a badly-planted lot of bushes. Good luck may befriend in all others save this one great operation.

9.—Filling up Vacancies.

The filling up of *vacancies* is one of the hardest and most thankless tasks the planter has imposed on him. The old saying, "prevention is better than cure," is nowhere better illustrated. The bulk of vacancies are undoubtedly due to careless planting at the very outset. If all that care and labor could do to preserve plants in the first and second year of their existence was done, there would be about ninety per cent. less vacancies to complain of. Lengthened and severe drought of course is a calamity which no forethought or trouble could successfully cope with; but the poor seedling's careless transplanting, and the unchecked ravages of insect pests, should certainly not, as they very often are, be allowed to be causes of patchy unproductive fields of tea. A certain number of vacancies or deaths among the best-planted acres must be inevitable. Some three to five per cent. may be completely beyond the help of man, and a certain percentage of plants will degenerate and certainly occupy a place, but yet be quite unproductive. However, the fact remains, that whatever be the cause, fully ten per cent. of an entire plantation must be replaced or replanted almost yearly. This may seem inapplicable to certain splendid-looking patches or few acre plots, but let an acre's full enumeration be made of plants *non est* or unproductive for some reason or another, and the above estimate will be more than confirmed, it is much to be feared. If, as soon as the transplanting is finished, the newly-put-out plants be carefully examined and persistently filled up with the best seedlings from the *supply* nurseries during the remainder of the rains, and from the *reserve* ones the second and third year, a very fair lot of plants of the right sort and number will be the result. Let extra trouble be taken with the lifting, planting, weeding, and perhaps watering, of a seedling placed in a vacancy; the chances are, there will be no cause to grumble.

However, the most troublesome and fruitless task is to fill up vacancies among large old bushes. Before commencing the actual work of replacing the missing plant, it would be as well to discover why that plant died? If it was washed out, all the soil that a seedling could possibly live in must have been washed away as well. If white-ants destroyed the old plant, its surroundings, *viz.*, clay, denuded of an upper layer of mould, must be favorable to the seedling being attacked as well. If grubs cut up the old roots, they will then more eagerly devour the tender new ones. In short, the tender substitute is more than ever liable to be also destroyed.

Therefore, we must try and remove the cause of death before risking a new plant. If the *slope* on which the plants have washed off is to be replanted, it must either be terraced or re-sorted, or perhaps both; for it is no possible use putting a seedling to be starved on a substratum of hard clay. If white-ants have killed the former plant, dig out what remains of the old roots and stump, fill the hole, previously limed with fresh mould and manure. If procurable, plant in it a healthy seedling, and keep it carefully hand-forked. If grubs have eaten the old roots, exterminate them first, replace the mould if necessary, and be continually on the look-out for the leaves of the new plant looking yellow; for if they do, the grubs are at their former tricks again.

Not only must the most practicable expedient of sowing seeds, or previously transplanting seedlings, into baskets, flower-pots, earthen or bamboo tubes, which again are bodily put into the vacant holes to be filled up, be practised, but the plants must be protected when once they have been put out. Three stakes driven firmly in and tied together at the top, or bamboo bottomless baskets pegged down, or merely a single stake, must be placed to mark its presence; but all such plants must be specially hand-weeded and hand-forked, previous to the general hoeing the neighbouring bushes receive. The coolie when hoeing is either much too busy or too careless to notice the little fellow, and it is either chopped down or dug up, and thus ends all the poor planter's hopes!

Large deep holes, fresh mould, continual hand-weeding and protection from rude assaults, in order to enable the young stranger to cope with its big neighbours with any chance of self-preservation, must be an axiom in filling up vacancies. All this trouble must be taken to avoid the stunted, seed-laden, degenerate over-grain seedlings that one so often sees trying to do duty for a defunct bush.

When large patches are completely bared by wash on a slope, or killed by stagnant water at the roots in a hollow, the terracing and re-soiling of the one, and the thorough draining of the other, becomes a matter of such labor, time, and expense, that it becomes a question if it would not be more profitable to put out a new plot than to refill the bare one. The former would certainly be the more satisfactory.

10.—TERRACING.

TERRACING seems such a simple and sure remedy for the total check of wash, better cultivation of the plant, and utilization of otherwise unprofitable, steep, though rich, land, that it is wonderful how few planters will resort to it, or even entertain the proposal. *Terracing*, or reducing the steep slope of a hill to a series of little flats, or converting it into a gigantic flight of steps, is really a very easy and, in the long run, if not at the outset, a cheap operation. A week's patient practice and standing over will enable a gang of coolies to terrace a hill side pretty nearly as fast as they can stub and hoe it for the first time after cutting and burning the jungle.

The land having been cleared with axe and fire, and all straight saplings on it carefully preserved, the leader of a gang of four or six coolies will commence hoeing a furrow, as level as possible, on the highest part of the slope. The man immediately

after him, guided by the furrow, will dig large clods and lay them parallel to the furrow, three and a half or four feet lower down the hill. These clods will mark the face, the furrow, the back, of the terrace. The two or three coolies coming next will dig the earth between the furrow and the line of clods, and drawing it towards them will form the terrace itself. These men must utilize every sapling and stump that comes in their way to hold up the face of the terrace, by using the stumps as pegs, and the saplings, now cut down if too numerous, as horizontal supports, resting them against the stumps. The last man of the gang will cut the back of the terrace in a slight slope, and will generally dress the surface of the terrace, breaking down clods and filling up hollows. As soon as the gang have got a little ahead with their terrace, a similar gang will commence another terrace immediately below and parallel to the first one, and so on right down the whole hill side. Putting single men each to do a bit of terracing by himself, produces a very patchy irregular result, not at all desirable. The first terrace is the one with which the greatest pains should be taken, for, as all the lower ones are guided by it, they will all run up and down instead of being quite level. The *Sirdar* should, if possible, stand on an opposite hill, from whence he can commence a complete view, and direct the men. A steep slope necessarily has more, though narrower, terraces cut on its surface than an easier one. Consequently, if the hill side bulges out, or assumes a bolder slope, or becomes suddenly depressed, it will be necessary to end by abruptly rounding off a terrace and going on only with the next lower one. However, coolies soon become very expert, and overcome any obstacle they meet with.

The surface of a terrace should invariably slope into the hill, specially so in a newly made one, otherwise the rain will make worse gutters, through the faces, which are composed of soft earth, than over unterraced land. Use every stone procurable for building up the faces substantially. It will be seen that no hoeing is required. The terracing is the first hoeing itself. However, trenching to perfection can be done right down the middle of a terrace, leaving a foot on the face and six or eight inches towards the back. After trenching, the staking should be done. In close planting, the stakes are merely two or three feet apart from one another along the terrace. Consequently, the bushes run in snaky lines along the hill side. By far the better method is to lay perfectly parallel lines of stakes up and down hill, each stake falling right in the middle of a terrace. For a steep gradient, three-feet wide terraces are recommended; for an easy slope, four feet. However, each terrace will require an extra six inches, lost in the slope, given to the face. Therefore, if the plants are put in straight rows up and down hill, four feet apart, on three-feet terraces, the distances they will stand apart from one another will be four by three and a half feet; or on four-feet terraces, four and a half by four feet; the former suitable for low class, and the latter distances for high class hybrids.

A little reflection—but better still, an acre of terraced slopes—will soon convince the most sceptical of the immense superiority of terraced over plain slopes. The only real objection is that the richest surface mould is drawn into the face of a terrace. However, the plant will eventually send its lateral roots, one side at least, to feed on this nourish-

ing soil; while, without terracing, the entire surface would soon be washed bare, if any cultivation was given the plants. While, the objections on the score of too rapid evaporation from off the face of the terraces, and smaller tasks of hoeing, especially the latter, are entirely theoretical, and easily disproved by the grand convincer—Experiment! In fact the only way to cultivate, manure, and preserve your soil and bushes, is by *terracing* the slopes on which they are planted.

PART II.—CULTIVATION.

Preliminary Remarks.

Before proceeding to describe the various operations included in the cultivation of the tea plant, it would be as well to have a clear idea of how a plant is constructed, lives, grows and produces others of its own species. The following extract has been made from a most admirable paper, entitled, "Remarks on the Pruning of Tea," by Dr. King, and printed in Vol. III, Part I, New Series of the Journal of the Agricultural and Horticultural Society of India, 1871 :—

"The organs of flowering plants may be divided into vegetative and reproductive. The vegetative organs are those by which the life of the individual is sustained, and by means of which it grows; they consist of root, stem, and leaves. The reproductive organs (consisting of flower, fruit, and seed) are concerned with the continuation of the species by the production of other individuals, and they are supported by the plant for this purpose. It is with the former set that we are now chiefly concerned. The structure of each and all of these parts (however much they may differ from each other in texture and external appearance), is fundamentally the same. Each consists of an agglomeration of vegetable cells. The vegetable cell, which is thus the ultimate element of vegetable anatomy, consists typically of a very minute spherical closed sac, with certain fluid and occasionally solid contents. It is in fact a tiny bladder filled with fluids and solids, the membrane being thin enough to allow of the passage of fluid through it. But although typically spherical in form, cells are rarely so in fact. Some are developed into ducts and cylinders of various sorts, for the transmission of fluids in the stem and leaves; others are lengthened out into spindle-shaped bodies, and made up into small faggots for the formation of wood; many are flattened into brick-like forms for the construction of bark, and into tiles for smoothing off the surfaces of the leaves; while an immense number are used as packing material or padding, and are stuffed in wherever there is a blank to be filled up in the internal structure of leaves. The pith of young plants is also made up chiefly of cells squeezed into a variety of shapes by pressure. But modified as they may be in form and function, they all remain essentially cells, and while young, the walls of all have the property of giving passage to fluids and gases. The cells in old wood, however, are exceptions, as their walls having become thickened, and their cavities obliterated, they are nearly, if not entirely, impermeable by fluids."

If the stem or branch of a tea plant be cut across and examined with the naked eye, the following parts will present themselves. In the middle of the stem, if it be an

old one, there will be seen a cylinder of hard wood; and encircling all, the layer of bark. When examined microscopically, the central cylinder of wood is found to be formed chiefly of spindle-shaped cells laid close together vertically, and with their tapering ends overlapping. In old wood, as has just been said, these have become incapable of transmitting fluid, and therefore of performing any vital function; and the wood formed of them is useful to the plant merely as a mechanical support. This explains how trees that have become hollow from the decay of the wood in the centres of their stems can continue, nevertheless, to throw out leaves, and to yield flowers and fruit. The structure of the encircling layer of young or sap-wood differs in no way from that of the hard wood, except that the walls of the spindle-shaped cells, of which it is mainly composed, are thin and pervious to fluids, and the cavities of the cells are themselves filled with fluid. In stems of plants that have not attained a sufficient age, no central cylinder of hard wood will be recognisable. The whole of the woody tissue will in such stems be found to consist of sap-wood, which will, however, be of greater density towards the centre. When the sap-wood is cut across, a greater or less amount of fluid will at certain seasons exude, and this is the layer which, in the language of gardeners, "bleeds" if cut while the sap is rising. Outside the ring of sap-wood, is the bark which is composed of several layers, the inner of them being vascular and affording passage to fluids, the outer mainly protective.

The woody parts of the root of a tea plant, being in reality merely stems situated underground, will be found to resemble the stem-proper in structure. The real roots consist not of the woody parts which give mere mechanical support, but of tender fibrils which proceed from these. These fibrils are composed of cellular tissue permeable to fluids, and, as will be seen presently, they are the chief means by which the plant collects its food.

The leaf, which is anatomically but a flattened expansion of the branch, and which retains an organic connection with the branch, consists of a mass of loosely packed cells confined between two cellular membranes (which form the skin on its upper and lower surfaces) and penetrated by spreading bundles of fibres and vessels—the so-called "veins"—derived from the branch. These loosely packed cells, as well as the vessels of the leaf, are freely permeable by fluids. The root, stem, and leaves, of which the above is a rough account, form the organs of a plant's digestion and assimilation, and therefore of its growth. The materials of its food must now be considered, and also the mode in which these materials are taken up and digested.

Plants cannot take in solid food. Whatever they absorb must be offered to them, either as a fluid or as a gas. The gaseous food of plants, in as far as it is absorbed in the state of gas, may be omitted from particular consideration at present. It is in the form of fluid that the great bulk of their food is taken up. This fluid consists of the natural moisture of the soil, and of the various salts of the earth and of manures which that moisture may hold in solution, and is absorbed by the delicate root fibrils which radiate in all directions in search of it. Collected from the soil by the fibrils, this undigested fluid is conducted to the stem where, avoiding the hard heart-wood, it passes into the part described above as the young or sap-wood layer,

and, transmitted from cell to cell, passes upwards through the main stem along this layer, enters the corresponding layer in the branches, and finally reaches the flattened expansions of these which we call leaves. This ascending undigested fluid is known as the crude sap. Having reached the leaves, and there becoming exposed to the influences of light and heat, this sap parts with a large amount of water by evaporation, and undergoes certain chemical changes. Thus altered in character (and as it were digested) by the process to which it has been submitted in the leaves, &c., the sap is now no longer crude, but has passed into the condition in which it can be directly assimilated as nourishment by the cells of the plant. Up to this point the sap had been transmitted upwards in obedience to certain physical laws, and during the upward passage, probably no nutritive function had been fulfilled by it. Before parting with the fluid which they have thus elaborated, the leaves retain as much of it as they require for their own nourishment and growth, and the remainder they return to the branches and stem, mainly through the vascular tissues of the inner bark, *i.e.*, the ring immediately outside the cambium. Passing downwards through these vessels as its main channel, the elaborated sap is distributed to all the growing parts of the branches, stem, and roots, and in fact affords to these, as to the leaves, the materials of their nourishment and growth. It is thus clear that the leaves are organs of very great importance in the economy of a plant's life, and indeed in the mutual interaction of these and of the roots, its life may be said to consist. The truth of this is well illustrated in the structure of the seed, which, in the class of plants to which tea belongs, contains the rudiments of two leaves and of a root, with sometimes a little store of nourishment in addition. The parent plant supplies these to its offspring to enable it to start in life, and the very first thing that offspring does, when in the fact of germination, it begins life on its own account, is to send the two embryonic leaves upwards, and the embryonic root downwards, and so begin the mutual process above mentioned, and thus become a living thing.

The evaporation which takes place in the leaves, consequent on the exposure to the air of the crude sap in them, is a potent cause of the ascent of that sap in the stem, and of its collection by the roots. As long as the leaves remain green and healthy and continue exposed to air and light, so long will the roots go on collecting from the soil, fluid which the young wood of the stem will transmit upwards in a steady stream. The vigour of the one process is accurately proportioned to that of the other. The roots will not long collect, neither will the young wood of the stem transmit, fluid for which there is no demand in leaves above. If from any cause the demand made by the leaves should be suddenly reduced, (as it would by the removal of branches in pruning), the supply of sap which had been collected to meet the previous demand would thus become excessive, and the excess would be got rid of either by the discharge known to gardeners as "bleeding," or by the plant making an effort to utilize it by rapidly putting forth new shoots and branches. Suppose, for instance, that a tree in full health and vigour be cut down close to the ground, either of two things may happen, the sap in course of collection by the roots will either simply

run to waste on the surface of the cut stem, or a growth of young shoots will spring up round the margin of the stump, or from the underground stem. Shoots originating in this way are known in Forestry as *coppice*, and the vigour and rapidity of growth shown by many of them, though often surprising, is easily explained when we consider that they are nourished by a root-system calculated for the leaf-system of a tree. If shoots arising in this way be persistently cut down as fast as they appear, and the root-system be thus deprived of all demand for its collections, and as it were of all object in life, it will soon decay and die. It is needless to say that, on the other hand, the growth and vigour of the leaves are modified by circumstances affecting the roots, and that any injury to the latter soon tells upon the former.

II.—Weeding, Hoeing, and Forking.

Weeding with the hand, or with the *koorpie*, is the only way of getting rid of the fine jungle and surface grasses, that grow so rankly, especially in the rains. If a planter would only make up his mind and stick to it, to commence immediately his transplanting was finished or as soon as the soil was softened enough by rain, to allow of the uprooting of weeds among his seedlings and keep all hands on, going over and over the garden, waging war with the young jungle, before it had time to flower and seed, he would be in the enviable position of having next to no weeds by the time he wanted his coolies for plucking leaf and making tea!

To be able to hand weed young tea thoroughly, the soil must have been properly prepared. There must be no grass coming up like mustard and cress all over the fields, that a horse could hardly pull out, nor must there be numerous stumps and unstubbed roots, to send up clusters of shoots, too strong to be uprooted. The weeds should consist of creepers and soft, shallow stuff, that can be taken up by the handful, the earth beaten out and thrown into a heap, not to be wasted but dug into the soil, to lighten, ventilate, and enrich.

However numerous or strong the weeds may be between the trenches or holes in which the plants stand, they should be comparatively scarce and weak immediately round about the seedlings. Because all the upper layer of earth, containing the roots and seeds, from which the weeds spring, should have been, if the trenches or holes were properly made, sent to the bottom, and all the lower earth should have been kept at the surface. Of course some of the two soils must get mixed up, hence the inevitable crop of weeds.

The general and most beneficial use of weeding is to keep young plants, for the first two years at least, clean. The only instruments that should ever be allowed among young seedlings are the *koorpie* and hand fork. The *khodalee*, supplying as it does the place of hoe, spade and pickaxe, however admirable an implement in its proper sphere of usefulness, must be strictly banished from among young if not all plants. This may seem a most revolutionary idea to the conservative planter, but let him remember that we live in an age of changes, it is to be hoped, of a progressive character, and resign himself to the current of liberalism, lest he prove an obstacle and be carried of his legs, by the proprietor! Seriously speaking, if any one doubts, or rather does not doubt, that the *khodalee* is a sort of

inspired instrument and a *multum in parvo* of all a planter's requirements in the shape of agricultural implements, let him select two patches of tea contiguous and of equal size, shape, &c. Use the *khodalee* in one, and the fork, already described, on the other. Note the result, in the appearance of the bushes, the yield and the condition of the two soils after a year's work. And then decide in favor of the really better tool.

However, if he cannot be persuaded to relinquish his beloved *khodalee*, let him send a gang of second class men, old women and children, above the mischievous age, to weed round every young seedling previous to hoeing. The neglect of this simple precaution entails the destruction, accidental or wilful, of thousands of seedlings yearly, on an extension or newly-filled vacancies. Under any circumstances the *khodalee* should never be allowed within nine inches or a foot, all round, of the young plant. Otherwise side branches and roots suffer barbarously.

Hoeing, or digging up the soil with the *khodalee*, must be light or deep according to the time of the year. Immediately the manufacturing season closes, generally at the end of November, the *deep* hoeing of the bearing plant must commence. This digging should be certainly *a foot deep*, and the clods should be as large as possible, and merely turned over, *not broken*. The object of leaving the ground quite rough is to ventilate and sun the soil, without which the earth would get cold, musty, and sour. However, if there be grass roots in any patch, the clods must be taken up and the roots picked out and burnt. The *khodalee* must not be allowed to approach too close in under the bush, as the limit of the branches pretty generally indicates the extent to which the roots spread.

Following the hoers should come the pruners, and following the pruners, a gang of women and children with hand forks, opening out the soil left undug, weeding among the stems, scraping off moss and the clay left by white ants, and burying round the stem all the prunings. The immense benefit of this system of supplementary cultivation is too manifest to be enlarged upon.

As soon as the plucking commences, not before, otherwise the new shoots would be grievously injured, a gang of men should be told off, say one to every two acres, to keep hoeing one clod, or six inches deep, throughout the plucking season. Thus the entire plantation should be hoed once every two months, or about four times from April to November. The measuring stick, alluded to in the preparing of land for sowing or transplanting, should be constantly used. As no work can be so scamped as hoeing by the best of coolies unless checked. *Forking* will now be attempted to be shown to be vastly superior in every way to *hoeing*, or digging with the *khodalee*. (1) In *hoeing* the soil is dug downhill, the lower side of the plants being partially barred and the topmost portion of the slope completely denuded of surface soil. In *forking* the clods are all carried up, the bare sides of the plant covered, and damage done by wash to a great extent repaired. (2) In *hoeing* the clod is merely tumbled about, and the under side not properly exposed, nor the weeds on the surface really buried. In *forking* the clod is turned quite upside down, each clod overlapping the one immediately above all, the long weeds are covered and their roots fully exposed to the sun. (3) The *khodalee* cannot approach the stem, because, being a *cutting* instrument, it is brought

down like an axe, and would consequently injure the branches and cut the surface roots. The fork, on the other hand, being used like a spade, and being a *piercing* instrument, generally avoids injuring the surface roots, and consequently can stir the soil right up to the stem. (4) The *khodalee* being necessarily used, in the downward stroke, in a very bent attitude, tires the coolie far more than the fork, which is used in a more upright position, and in the use of which the legs assist the arms. (5) The *khodalee* cannot be used on terraces without jeopardising the plant and the face of the terrace. The fork is the only implement suited for terrace cultivation. (6) The *khodalee* will not penetrate more than six or seven inches in depth at a stroke, as in light hoeing, the fork can, with the same expenditure of force, be pushed in nearly a foot and will turn up a much bigger clod.

Having cultivated with the fork for three years, throughout the twelve months, the writer can vouch for the practical demonstration and accuracy of the above facts in which any practical British Agriculturalist will bear him out.

The perfection of soil culture can be obtained by providing each forker with a sickle or reaping hook; the size known as B. X. 4 is recommended. Previous to forking he cuts all the jungle close to the ground and collects a little heap between every four bushes. He then begins forking, and as he takes up the clods below a bush and makes a trench, he takes up a forkful of weeds and puts it in the hole, which he covers over with the next lot of clods. In this way every blade of jungle is destroyed and placed within *feeding reach* of the plant. Of course, the use of the fork is not practicable in soil that never has been thoroughly broken by the *khodalee* in the first preparation, and the only way to remedy this culpable negligence is to dig a good sixteen to eighteen inches deep with the *khodalee* in the cold season and then keep up the forking regularly. The crust may harden in stiff soil and dry weather, but the keen prongs of the fork are powerful persuaders. The forked hoe, a thing like a nondescript *khodalee*, is a swindle! being neither the one thing nor the other.

Three thorough forkings can be given by the same number of men and with far better results than the four light hoeings mentioned above, during the plucking season. The best steel forks only should be used.

12.—PRUNING.

Pruning is one of the most difficult operations in the culture of plants which are grown under such artificial circumstances as the tea bush. When we consider that *pruning* is the art of restoring and remedying the disordered state of the stem and branches of a plant by cutting and hacking them, so as to rid the plant of such portions as are unwholesome or unprofitable, and thus force other branches to more regular or greater production; when we remember that all art is merely the practice of the theory taught us by the scientific investigation of the subject, and that the art of pruning is the putting in practice the truths taught us by the science of vegetable physiology, we must acknowledge that to prune a tea tree properly, so as to make it produce in abundance and of the best quality, the leaves that we grow it for, is not

learnt easily or worked by rule of thumb, as many planters would lead people to suppose. It is not meant that every planter must be a botanist; but that, getting a clear idea of the structure and organs of a tea plant, and the climate and soil in which it is grown, he must adapt his pruning to the knowledge he thus gains. To hack and hew a bush by the assistance of a foot rule, as some advise us to do, is simply folly, if not something worse.

We have seen from Dr. King's remarks, already quoted, that the sap or vital juice of a plant is gathered in a crude state by the thread-like rootlets that push out in every direction from the main roots, as branches do from the main stems, and that this unrefined sap is drawn up through the pith of the roots, stems, and branches, into the leaves, and there refined and made fit plant-nourishment by exposure to light, heat, and the atmosphere. That, after being thus refined, it passes down through the bark, and nourishes every part of the plant, and causes new shoots to develope from the axiles or little eyes at the base of the leaves on the younger wood, and the little scars on the surface of the older wood. We can easily understand why the pith, leaves, and bark, must be kept in first-rate working order, and not allowed to be choked up, stripped off, or wounded either accidentally or wilfully. The pith or collection of minute cells between the core and bark, gets woody or choked up as the stem and branches get older; the bark gets unfit to convey the sap as it gets old, scabby, and diseased; and, as we cannot prevent the stem and bark getting older, we must try and get new stems covered with fresh bark. Let it be noted that disease is not the cause of a bush yielding badly, but the effect of neglect or ill-treatment. And as, when a human being's leg, arm, or body breaks out in skin diseases or sores, the doctor does not cut off the whole arm or leg or hew the trunk in pieces, but removes only the diseased part, with caustics or the knife, and then makes the patient swallow medicines and eat proper food to cure the diseased or poor blood, that has caused all these eruptions and sores; so, when a tree becomes diseased, its stem gnarled and cankerous, its bark scaly, rough, and moss grown, its leaves dull, ill-developed and leathery, we must not fly to the pruning knife and handsaw to hack and cut the entire bush down: we must use the knife to remove only such portions as are hopelessly incurable, and try what cultivation, manure, and proper plucking will do to bring the bush round.

We must never forget that the severity of a surgical operation is, except perhaps in the most desperate cases, always proportionate to the stamina of the patient. Similarly, when contemplating how bushes are to be pruned, we must never forget to proportion the severity of the cutting to the condition of the bushes and the richness or poverty of the soil they are growing in.

With a lot of really bad bushes in poor soil, do not resort to the knife at the commencement of your treatment. Cultivate and manure the soil as liberally as possible; then remove the dead wood and cut off the wiry seed-bearing branches, and the crow's feet or ends of branches from which numerous stunted shoots spring, presenting the appearance of a worn-out broom, the branch being the handle.

The cultivation, manuring, and light pruning, having been done in the cold season, when the tree, as far as growth is concerned, is inactive, watch the result of the return of stimulating sap and the growing

period in Spring. If vigorous buds and shoots begin to develope and grow in the place of the stunted stuff cut away, congratulate yourself on having cured the bush, or at least put it in a fair road to recovery and productiveness. But if, unfortunately, the bush does not respond to your call, then it is a desperate case of cure or kill; and all you can do is to wait for the rains, and cut the bush down to within three or four inches of the ground. This ultimatum is issued with the intention of calling forth all the life and energy left in the roots, since there is none in the stem to throw out new stems from the collar or junction of root and stem. A bush will have to be actually in extremes not to *coppice:* and then all that can be done is, if the soil and lay of land is worth it, to stub up the old bushes and replant new ones.

However, if the former treatment has been efficacious, some new stems are sure to sprout out from the collar, especially if hand-fork cultivation has been given during the spring and summer. For each well-developed new stem cut out the worst or least productive old stem during the next pruning season. In this way a bush may be renewed in a year or two instead of butchered in five minutes.

Thus far, pruning has been made to apply as a remedy or *restorative.* Now we must examine it as a *corrective,* which, in conjunction with the tonic of manure, must be resorted to annually, to overcome the ill-effects of the season. As must be obvious to the least observant, to prune, one must have wood to cut. To have wood to cut, it must be allowed to grow. To allow it to grow, it must not be plucked the instant it begins to push forward. Though all this sequence may be so very obvious, yet one would not think so, judging by the method of plucking adopted by a great many at the very commencement of the season. No sooner an unfortunate shoot is an inch or two long, then off with his head! And so on right through the season. Of course, when the pruner comes to cut this shoot he finds that there is little or nothing to cut, and what there is, is not of the slightest use cutting. In short, the surface of the bush is a mass of crows' feet, which must be cut clean off. This lowers the height of the bush yearly, denudes it of leaves, chokes up the sap channels, and reduces the bush to the state in which the cure or kill treatment has to be resorted to. Or else the miserable collection of stunted twigs are just shaved or scraped with the knife, and a sickly, short, leathery, but numerous flush produced. The method pointed out elsewhere, under the head of plucking, having been adopted, the bush at the end of the season is covered with spikes of young wood, more or less the thickness of a lead-pencil. There are five distinct kinds of wood in a properly treated bush; (1) gray wood, the oldest stems; (2) wood, the color of a green pear; (3) silver gray or pink wood with streaks of gray, as if froth had dried on it, one year old; (4) bright brown red wood of the present season's growth; and (5) the last grown green flush. The last three kinds of wood are all the growth of the past season. The green wood, though it can hardly be called wood, is non-productive, *i.e.,* if pruned it would not produce a flush. The red wood is also too young to produce a vigorous flush. The third-mentioned wood is that which will produce the finest flush of all: consequently it should be pruned about half an inch before it becomes the red or fourth-mentioned wood. Another point that must be carefully attended to is, wherever

possible, to leave a leaf an inch below the cut. For it must be remembered that at the base of every leaf there is an axile or little bud, that will develope into a shoot as soon as the sap rises in spring. Your aim must therefore be to develop as many of these as possible, and by cutting high enough above the leaf, not to injure the bud at its base. In new stems, that have grown up from the collars or main stem since the last pruning, nearly every bud will develop into a vigorous shoot: hence the advantage of encouraging such new stems to replace old ones. Perhaps it will be clearer to the reader to describe the pruning of fully-matured bushes, five years old and upwards, through the whole process. (1) All suckers of a long lanky nature must be cut close off. (2) All wiry, seed-bearing branches, easily distinguished by the flowers on them, all up each stem, must be cut off, unless seed growing is to be encouraged. (3) Cut off all the thin shoots that have developed from the axiles on the bases of the lower leaves on a one-year-old wood. However, if this wood has branched into two or three of equal and vigorous growth, each must be regarded as pruning wood. (4) Having thus cleared the bush of suckers, seed-bearers, and ill-developed shoots that choke up the bush with useless foliage, examine each branch to be pruned on its own merits, and (*a*) cut so as to get rid of the red and green wood; (*b*) cut so as to have wood about the thickness of a pencil or thicker; (*c*) cut so as to have the ends of the pruned branches not closer than three inches to one another; (*d*) cut so as not to lessen the leaf-producing surface of the bush; (*e*) cut so as not to have branches from one stem interfering with those on another; (*f*) cut so as to keep the bush more or less even, and not too tall to be plucked by women.

If you find too many stems, cut as low down as possible, without injuring the others or the collar, the oldest and most distorted ones, but always have a new stem to take the place of the old one, so as not to diminish the number of stems; unless in some low China sorts, where some of the too numerous stems must be cut out. It may be taken as a general rule that the higher the class of plant, *i.e.*, the nearer it approaches the Assam, the more sparing one must be with the pruning-knife. It will not run to wood like the China variety, and bears fewer seed branches. An Assam plant cut down to a stump will generally *coppice* into a broom-like head absurdly disproportionate to the size of the stump.

13.—PLUCKING.

PLUCKING is really a continuation of the former process of pruning already described. It is both a means and an end. For, unless we *pluck* or finger-prune the new shoots that develop in Spring, the bush will clothe itself with a sufficiency of leaves for its internal economy, and then stop *flushing* or throwing out successive growths of new shoots.

Before proceeding to describe the mere mechanical process of plucking the leaves or shoots off a bush, it may be as well to consider the nature and use of sap, leaf-buds, and leaves.

The fluid matter, which is absorbed by a plant from the earth or air, is called *sap*. When it first enters a plant it consists of water holding certain substances in solution. These substances consist chiefly of ammonia, phosphoric and carbonic acids, and of alkaline or

earthy matter. Soon after its absorption into the plant, sap acquires the nature of mucilage or sugar, and subsequently becomes still further altered by the admixture of such soluble matter as it receives in passing through the *alburnum* (young internal sap-wood between the *liber* or bark and the interior heart-wood). When the sap reaches the vicinity of the leaves, it is attracted into them, and these being exposed to light and air, it is converted into the secretions peculiar to that particular species of plant. Finally, in its altered state, the sap sinks down the bark, whence it is given off laterally by the *medullary rays* (channels through which communication takes place between the bark and the heart-wood), and is distributed throughout the entire plant system. No solid matter whatever can be taken up by the roots, and it is owing to this circumstance that *liquid manures* act with so much greater energy than *solid substances.* The cause of the *motion of sap* are the *leaf-buds and leaves,* called into growth by the combined action of the increasing temperature and light of Spring, and attracting fluid from tissue immediately below them; the space so caused being filled up with fluid again attracted from below; and thus a motion gradually takes place in the sap from one extremity to the other; consequently, the motion of sap takes place first in the branches and last in the roots. Whatever tends to inspissate, or thicken sap, such as a light, dry and heated atmosphere, or to interrupt its rapid flow, has the property of causing excessive vigour in the plant to be diminished, and *flower buds* to be produced; while, on the other hand, whatever tends to dilute or thin the sap, such as a dark, damp atmosphere, with a free and uninterrupted circulation, has the property of causing excessively rapid growth, and an exclusive production of *leaf-buds.* Therefore, inspissated sap is the cause of *fertility or flowers,* and diluted sap the great cause of *sterility or leaves.* The conversion of sap into different kinds of secretions is effected by the combined action of *Air, Light,* and *Temperature.*

Leaf-buds are rudiments of branches enclosed within scales, which are imperfectly formed leaves. All the leaf-buds upon the same branch are constitutionally and anatomically the same, and are generated in the *axils* of leaves, and it is there that they are always to be found. If they cannot be discovered by ocular inspection, it may nevertheless be always inferred that they exist in such situations, and only need calling into life from their dormant state. Hence, wherever the scar or remains of a leaf can be discovered, there, it is to be understood, that the rudiments exist of a system of life which may be, under favorable circumstances, called into action. Leaf-buds are nourished by the sap lying in the pith and adjacent tissue or *alburnum,* and consequently their vigour will be in proportion to their nourishment. In some plants, buds detached from the stem will grow, sending roots downwards and stems upwards. But if these buds are left on the stems, the matter they send downwards forms wood and bark, and the stems they send upwards form branches. Every leaf-bud has, therefore, its own system of life and growth. If no leaf-buds are called into action, there will be no addition of wood, and consequently their destruction or absence is accompanied by the absence of wood; and with the free development of leaf-buds there will be a proportionate increase of wood.

Leaves are mere expansions of

bark traversed by veins and enclosed with an *epiderm* or skin. The veins consist of spiral vessels cased with woody fibre, and connected by loose *parenchyma* or pulpy pith, full of cavities containing air. The cells in these veins are so arranged as to have numerous passages for the circulation of air among them.

The *epiderm* is formed of one or more layers of depressed cellular tissue, composed of minute bladders filled with air. Between these cells or bladders are placed numerous *stomates* or apertures, which have the power of opening or closing as required. It is by means of these *stomates* that the leaves are enabled to absorb water and gaseous matter from the atmosphere, and to elaborate the crude sap they absorb from the *alburnum*, converting it into secretions peculiar to each species of plant. The loose cavernous structure of leaves enables them to bring the greatest possible surface of their *parenchyma* into communication with the atmosphere. The epiderm, being a non-conducting skin, protects the leaves from extremes of temperature, and allows vapour and gaseous matter to pass through easily. The *stomates* or pores of leaves are chiefly intended to facilitate evaporation, and thus reduce the watery crude sap to a proper consistency, as well as to emit air when desirable. As all the secretions of plants are formed or prepared in their leaves, it follows that a tea plant, unduly deprived of its leaves, cannot secrete sufficient theine to give the infusion of its manufactured leaves, (the tea we drink,) a sufficiently powerful and distinct flavour. And further, as this secreting property depends upon certain specific vital powers called into action *only* when the leaves are freely exposed to light and air, it follows that the amount of secretions will be in direct proportion to the *quantity* of leaves, their *area*, and their free *exposure* to light and air. Hence, bushes denuded of too many leaves, or standing under the shade of trees adjacent to or in the middle of tea fields, must diminish the quantity of theine secreted in the leaves plucked for manufacturing.

Having, in the foregoing sketch, seen how a plant is provided with mouths, stomachs, digestive organs, lungs, and systems of circulation, it is obvious that any disorder or destruction of the roots, leaves, pith, or bark, will infallibly lead to diminished vigour and productiveness, disease, and eventual death. This statement, founded on scientific reasoning, is amply supported by the experience of practical planters, who know that *a bush is made or marred by plucking*. They may not know the reason why, but we do; therefore let us adapt our *practice of plucking* to the *theory of growing*.

As soon as light and heat increases with the advance of Spring, small dull red points are observed developing in stem and branch, specially on vigorous young wood of last year's growth. These little points or *leaf-buds* develop, and, casting off their scaly envelopes, small imperfect leaves show a perfect rolled-up leaf, which, expanding in the genial warmth of the glad season, into a broad leaf, exposes another rolled-up leaflet, which in due time unrolls also. And so the growing and expanding goes on till a tender green shoot, clothed with six or eight alternate leaves, with an unopened one still leading the way, is ready for the plucker in March. However, before all these six or eight leaves have been attained, the axils of the two or three lower ones, feeling the vivifying influence of the elaborated sap pass-

ing down from the upper leaves of the shoot, burst out and give birth to *leaf-buds*, which likewise grow into shoots. These new shoots are the *second flush*, which in due time develop other ones from the axils of their leaves, which become the *third flush*, and so on till cold weather and the stoppage of the rains stops further growth for the year.

The second flush having got a start, and its leaves having commenced pumping up, absorbing and elaborating sap on their own account, one can, with safety, remove or pluck the upper or three last-formed leaves of the first or spring flush; and the sooner it is done the more rapid will be the development of the second flush. The same process must be adopted for the removal of the second and all succeeding flushes; only, the intervals between each plucking will get shorter and shorter, and the number of leaves grown and plucked on individual shoots will get fewer and fewer, as the season advances. For, we have seen that the thinner the sap gets, the quicker and more numerous are the leaves in developing; and, during the rainy season, the sap will of course be more watery than during dry weather.

The above is the general *theory* of plucking, but of course circumstances must arise which must be attended to, and the *practice* of plucking adapted accordingly.

When deciding the actual way of plucking a bush, you must consider (1) its age, (2) how it has been pruned, (3) the weather.

Plants under eighteen months' old, reckoning from the time the seed was sown, either *in situ* or in the nursery bed, should not be plucked on any excuse. If inclined to be too tall and lanky, cut off the main stem fifteen to twenty inches from the ground during the pruning season. This will check upward, but will encourage lateral growth, and make the plant *bush*. In the July following the first year, or about a year after they have been transplanted, the shoots leading *upwards* will begin to get irregular—and want trimming to be kept pretty level: then, and then only, may the two topmost leaves—the unrolled leaf is never reckoned—be nipped off by the plucker, more for the sake of forming a shapely bush than making tea. When plants have attained thirty months, they may, with safety, be *lightly* plucked, taking great care to *encourage lateral growth*. After this season, *i.e.*, when the plants have been pruned for the third time, regular and systematic plucking becomes necessary and profitable.

Supposing a bush, four years old or older, has been *badly plucked*, *i. e.*, the new shoots not allowed to develop sufficiently, but *clawed off* whenever they are big enough to be caught hold of by the plucker, (this method some call "clean plucking") the consequence is, that it is full of *crow's feet*, which have all to be cut out, and the bush properly ventilated *and liberally cultivated, if not manured.* It is not to be supposed that a bush can be plucked without making *crow's feet*, though not the hard, broom-like, stumpy bunches of twigs, clearly showing premature and indiscriminate *clawing* rather than plucking. At the end of the plucking season the new shoots that grew last spring should show a clean stump, four to six inches long, branching off, again and again, somewhat like straight antlers; the entire growth being a foot or eighteen inches; so that, when the pruner cuts below the lowest fork, there will be a clean, lead-pencil-like stump left, with a couple of well-developed leaves.

It is from the axils of these leaves that the finest portion of next year's leaf and wood will spring. However, if the *clawing* process has been adopted, the stumps left after pruning will be wood, at least, of two years' growth. The new shoots that spring from the visible and invisible axils on these stumps, must be allowed to grow until the *second* flush makes a very decided appearance, say an expanded and the unrolled leaf. *Then* the two and a greater portion of the third leaf can be *nipped, not stripped off*. The *modus operandi* of nipping and stripping will be fully described further on. The reason of not taking off the entire lowest leaf plucked is this,—that such an act would injure the axil at its base, and thereby prevent another shoot, the next flush, developing, as it is practically impossible to remove the entire leaf without wrenching it bodily off the stock, and leaving a cavity immediately below the axil, or carrying it away altogether with the leaf so taken off. The distances measuring along the stalk will decrease gradually as leaf upon leaf develops. The greater the distance between—sometimes four and five inches and even more—the leaves on a stalk, the better. On an ill-grown flush, six leaves will be found on a stalk four inches long; on a well-developed stalk the sixth leaf will not be reached till ten inches of growth have been made. The distances between the leaves, commencing from the lowest one, being three, two and a half, two, one and a half, and finally one inch. Therefore, plucking off two and a half inches, leaves seven and a half inches, which, when pruned just above the second from the bottom leaf, leaves a stump for next year a good four inches long, with two leaves and axils. The heavier the pruning, the fewer and more vigorous; the lighter the cutting, the more numerous and less vigorous will be the first flush of the following Spring. The nearer a plant approaches the indigenous variety of Assam, the fewer, larger-leafed, further apart on the stalks, and golden tinted, will be the flushes. The severer the pruning with hybrid bushes at least, the greater forbearance must be exercised in plucking the first flush. Low-class China bushes seem to require heavy pruning and "clean plucking" annually. It is little use expecting a China bush to bear a long flush, and the sooner five leaves are attained, and three plucked, the better.

The difference between *plucking* and *stripping* lies in the way the fingers are used. To *pluck*, the nail of the thumb must be applied to the tip or top point of the forefinger, and the stalk or leaf *cut* through. However, in practice it will be found that pluckers, if properly looked after, will *nip* the stalk or leaf between the thumb and slightly curved forefinger, and with a sharp *pinching twist* take off the leaf or stalk *clean* enough. *Stripping* consists in hooking the forefinger round the stalk, and with an upward motion *tearing* off leaves *and axils.* It will be obvious to the reader of the foregoing remarks, that, were such a vile, lazy practice allowed, the loss in the succeeding flush would simply be enormous. Stripping can easily be detected by examining the leaf baskets as they come in to be weighed at the factory. The *whole leaves* will show *stripping*; entire stalks and no loose leaves will show *bad plucking,* in so far as the lowest leaf has *not* been nipped off, leaving a third or quarter behind to protect the axil at its base; and stalks with a bud or unrolled leaf, two whole leaves attached and one three-quarter or two-third leaf

loose, will show *perfect plucking.* To make coolies pluck well, is one of the planter's easiest tasks. All he has to do is to go round and *personally show each sirdar* and *each coolie how to pluck;* and if he finds his orders not carried out, to fine the *sirdar* his day's wages, and the coolie his or her wages, and any extra pice due them for plucking over and above the maximum number of pounds fixed for a day's work. Extra pice should never be given *till after the first flush has been plucked.*

14.—MANURING.

As but little can be written on this subject which can be applicable to the individual circumstances of each reader, it will perhaps be more profitable to throw together some notes on the theory and practice of manure, and leave each one to pick and choose that which is most suitable to his own garden.

Fitted by nature to draw their sustenance, now from the earth, now from the air, and now from both, according as they can most readily obtain it, plants are capable of living —though rarely a robust life—at the expense of either. The proportion of food which they actually derive from each source will depend upon many circumstances—on the nature of the plant itself; on the period of its growth; on the soil on which it is planted; on the abundance of food presented to either extremity; on the warmth and moisture of the climate; on the duration and intensity of the sunshine; and other circumstances of a similar kind; so that the only general law seems to be that, *like animals, plants have the power of adapting themselves to a certain extent, to the conditions in which they are placed,* and of supporting life by the aid of such substances as may be within their reach.

To comprehend how plants grow, we must examine their organization, and study the nature of those substances which constitute their food. The organization of plants has already been sufficiently explained. We will therefore now confine ourselves to the study of plant food.

The principal simple chemicals that influence the growth of vegetation are—*carbon, oxygen, hydrogen,* and *nitrogen.* All other substances are compounds of two or more of these simple elements. *Carbon* is a chemical element, abounding in nature, the most familiar form of which is *charcoal.* It exists in the atmosphere in the form of *carbonic acid gas,* and in the decayed vegetable matter commonly called vegetable mould. *Oxygen* is an element known only in the state of gas: it is void of color, taste and smell. It exists in the atmosphere, in water, and in minerals, and is necessary to the life of both plants and animals. The water which plants imbibe consists in great part of *oxygen,* the atmosphere which surrounds them contains twenty-one per cent. of its bulk of *oxygen; carbonic acid gas,* from which they derive their *carbon,* consists of seventy-two per cent. by weight of *oxygen;* and it enters more or less into the composition of all *organic* and mineral substances. *Hydrogen* is also known to us only in the state of gas, and when perfectly pure is scarcely distinguishable from common air, without color or taste, and possessing but little smell. Most vegetable structures contain *hydrogen* in the form of water, which can be separated as such, and replaced by other bodies; but the *hydrogen* essential to their constitution cannot possibly exist in the

state of water. All the *hydrogen* necessary for the formation of an *organic compound* is supplied to a plant by the decomposition of water. The process, in its most simple form, consists in the extraction of *hydrogen* from water, in consequence of which either all or a part of the *oxygen*, combined with the *hydrogen* in water, is exhaled. This extraction of *hydrogen* from water may be effected by the leaves, tissues, and roots of plants. *Nitrogen* also is known to us only in the form of gas. It is without color, taste, or smell. *Nitrogen* forms only a small part of plants, but it is never entirely absent. It is found in the form of vegetable *albumen* and *gluten*, and in the seeds and various juices. There are therefore *nitrogenised* products of plants and *non-nitrogenised.* The chief source of the *nitrogen* of plants is supposed to be *ammonia,* which is the *nitrogen* of putrefied animal matter diffused throughout the atmosphere in the state of gas. *Ammonia* consists of a loose combination of *nitrogen* with *hydrogen*, and the compound is extremely soluble in water and acid.

The constituents of plants are divided into *organic* and *inorganic.*

Organic are those which are commonly known as vegetable substances or vegetable productions—*starch, gum, sugar, albumen, gluten,* &c. They are the products endued with life, and cannot be produced without the operation of life. They are the products of *living organs,* and are therefore termed *organic.* These substances are generally compounded of four simple elements,—*never less than three.*

The organic substances of plants consist of *silica, alumina, potash, soda, lime, magnesia, phosphate of lime, salt, sulphuric acid,* &c. These substances are generally combinations of two elementary bodies. They are wholly *mineral*; they are the products of the chemical action on the metallic or non-metallic elements of rocks; and they existed before plants or animals. When vegetable substances are burnt, there remains behind a portion commonly called *ash*, and this constitutes the *inorganic* portion. They form from one to twelve per cent. of the bulk of plants. *Wood ashes* are a very valuable manure, and are peculiarly well adapted to *gravelly soils* and *loams.*

There are *alkaline* and *earthy phosphates* that form invariable constituents of all kinds of grasses. But what we understand chiefly by the term *alkalies*, means *potash, soda,* and *ammonia*—the first being the *alkali of land plants*, the second the *alkali of sea plants,* and the last the *alkali of animal substances. Potash* and *soda* are *fixed alkalies,* and *ammonia* is a *volatile alkali.* The property of *alkalies,* to be especially borne in mind in connection with agriculture, is their great tendency to combine with acids, and to form, by that combination, what are called *neutral salts. Acids* constitute a numerous class of chemical bodies. They occur in all the kingdoms of nature: *phosphoric acid in bones, citric acid in lemons, sulphuric acid in minerals;* and are produced by burning, treathing, decomposition, &c. The acids are generally sour, but not universally. The fact to be especially remembered with regard to *acids* is the converse with regard to *alkalies; all acids unite or combine with alkalies and alkaline earths forming neutral salts; and acids also combine with the metals.* Thus they are actively and constantly engaged in the vegetative process, and possess great powers of combination.

The term *salt* is of wide and various application. But in relation to the subject under consideration, the

common salt, used as a seasoner and preserver of food, is a good example. This is the *chloride of sodium*, formed when *chlorine* and *sodium*, or *hydrochloric acid* and *soda*, come together. *Saltpetre is a salt.* It is *potash united to aquafortis.* These are united, and their characters are *neutralized* by each other, so that in saltpetre one will not perceive *soda* or *aquafortis.* They have formed a *neutral salt.*

The terms *carbonates, chlorides, nitrates, silicates, &c.*, are frequently used in agriculture, and may be explained to be salts formed by the mutual action of *acids, alkalies*, and *metals.* Thus *carbonates* (carbonic acid) of lime, magnesia, potash, soda, iron, and manganese. *Chlorides (chloric acid)* of potash, soda, lime, manganese, silver, zinc, &c. *Citrates* (*citric acid*) potash and lime. *Humates* (the *humic acid* of soils) of lime, &c. *Nitrates* (*nitric acid*) of potash, soda, lime, ammonia, &c. *Phosphates* (*acid of phosphorus*) of alumina, lime, magnesia, &c. *Silicates* (*acid of silica*) of potash, magnesia, alumina, &c. *Sulphates* (*sulphuric acid)* of ammonia, soda, magnesia, iron, copper, &c. Thus it will be seen that *the same acid with another base forms a different kind of salt.* The term *base* implies the leading constituent of a compound. Thus in *carbonate of lime*, the latter is the alkaline, earthy base. It is most important to remember that *any one of the many alkaline bases may be substituted for another*, the action of all being the same.

The whole argument suggests that by the analysis of plants we may arrive at a knowledge of their peculiar wants; and of soils and manures, we may take care that those wants are supplied.

It may be asked whence do plants obtain their principal *salts?* By the continual evaporation of the sea: its salts are spread over the whole surface of the earth, and, being subsequently carried down by the rain, furnish to vegetation those salts necessary to its existence. This is the origin of the salts found in the ashes of plants, in those cases where the soil could not have yielded it to them.

By the foregoing explanations, the substances to be found in plants—which is the same to be found in manures and soils—are reduced from *things not known to those that are known.* In this way anyone may feel familiarised with them without a deep acquaintance with chemical science. And it will be seen in a multitude of cases that the practical planter may understand the principles of the science, although ignorant of precise terms which represent and explain these principles. Thus the baker bakes bread on scientific principles, although he never saw a book on chemistry or learned the meaning of a scientific term!

Nature presents to man the example of preparing soil by the gradual processes by which she herself prepares the surface of the earth for the reception of the higher order of plants.

To devise an arrangement of soils at once comprehensive and distinct, is no easy task. The distinctions ought to be simple and obvious, without regard to minute difference which may be of no material importance. For practical purposes soils may be classed under the following general heads:—*sand, gravel, clay, alluvium*, and *loam*, or that species of artificial soil into which the others are generally brought by the effects of manure and of earthly applications in the course of cultivation.

Most *sands*, whether on the surface of the ground or in strata at a certain depth—whether forming the beds of rivers, or the shores of the

sea, are the fragments of disintegrated rocks, and are red, white, grey, or black, according to the rocks from which they were derived. The grains of sand are, for the most part, composed of *silica*, and soils containing it are called *silicious*. A sandy soil may be improved by a mixture of clay, marl or warp (the sediment of navigable rivers), peat or vegetable earth. It frequently happens that, under the sand itself or in its immediate neighbourhood, the materials may be found which are requisite for its improvement. Even light sandy soils may be rendered retentive of moisture and manures when mixed with the subsoil or ameliorated by admixture with other soils. In the management of sandy soils two rules are to be observed: (1) Never to pick off any small stones, that may be found in them, as they preserve moisture and hinder evaporation of the enriching juices, thus assisting vegetation; and (2) when farm-yard dung is applied to this description of soil, always to give it in a state of *compost*, with a view of adding to the tenacity of the soil, and of preventing the manure from being dissipated in a dry season, or washed away by rain.

The origin of a *gravelly soil* is the distribution over the face of the earth of particles of disintegrated rocks, larger than sand, chiefly by the action of water. Gravel having been dispersed by a more powerful agency than that which caused the distribution of sand, differs more widely in its qualities, because of its frequent admixture with various substances, organic remains in a fossil state, and especially clay, loam, flints, iron stones, &c. Hence there are rich gravels, hungry gravels, sharp gravels, &c. Sands will frequently be found to be the production of flat countries, gravels of the mountainous and rocky. Gravelly soils may be improved by *draining* if they are troubled with springs; by hoeing or ploughing deep; by mixing them with large quantities of clay, chalk, marl, peat or other earth; by repeated applications of manure, and by causing a *wash* on to them from surrounding *teelahs*. Vegetable matter fromn eighbouring *jheels*, *bheels*, tanks, ponds, and rivers are highly profitable admixtures for both sandy and gravelly soils.

Clay is a mixed natural earth, very widely distributed. It consists of a large proportion of *alumina* united to *silica* of various degrees of fineness, and frequently also a portion of *carbonate of lime*. The formation of clay deposits took place, according to geological theory, in consequence of the degradation and waste of certain portions of the globe, followed by a removal of the materials to localities of comparative tranquillity. In the formation of clayey deposits both chemical and mechanical agencies were exerted. The mechanical agency operated in the disintegration of solid parts and the removal of the fragments; and the chemical agency operated in the uniting of *alumina, silica, &c., into compact earth*. A clay soil is distinguished above every other for its *tenacity*. It is principally composed of particles of matter, many of them so small that, when separated from each other, they are imperceptible to the touch, and will easily float in water; yet these minute particles form a soil that is far more tenacious than any other species of earth. *Clay always contains iron* in a higher or lower degree of oxidation; and it is possible that this metal constitutes an essential part of it. Clayey soils may be improved by a suitable admixture of other soils to *ameliorate its texture*, such as common sand

and above all *lime*, *lane gravel*, peat moss, which has been for some time dug up and exposed to the action of the atmosphere; putrid *calcareous manures*, mixed with large quantities of *ash*, improves clayey soils in a wonderful degree. Also burning some portions to render it more friable, more especially if there is any *marl* in its composition.

The origin of *alluvial* soils is explained by the word itself, being that formed by rivers *washing down* vast quantities of sand, earth, stones and gravel, which when spread out to any extent form what is called *alluvial* land. The richest alluvial soils are to be found near the junction of large sluggish rivers with the sea, or where they meet in the valleys through which they pass; and the soil is most varied and heterogeneous in the composition of its parts, when these are in minute divisions and intimately blended together. Alluvial soils are the most fertile of all natural deposits, and are those principally in which an accurate analysis is required, because the proportion of their constituent parts varies in innumerable degrees. It may be laid down as a general rule, that *the most fertile of these soils are those in which the primitive earths are nearly in equal proportions;* silica being the most abundant, with about ten per cent. of *organic* matter.

Loamy soils are produced by similar causes to those of clay, but they are more fertile, because they contain more decomposed vegetable matter or *humus*. *Loam* consists chiefly of woody fibre in a state of decay, which, as it progresses, acquires a dark-brown color and then becomes *mould*. Loam is a native clay mixed with quartz sand, and occasionally with *carbonate of lime*, or a soil compounded of various earths, of which the chief are *silicious sand*, clay and *carbonate of lime* or chalk, —the clay predominating. With these substances the vegetable matter is intermixed. The treatment of loamy soils depends materially on their nature, whether they are sandy, gravelly, clayey, calcareous, peaty, or mixed in those proportions which are best for fertilization, as in *brown loam*.

All attempts to improve the nature of a soil should have for their object *the bringing it to a state of loam*, by the addition of those substances which are deficient. A loamy soil requires less dung to keep it in heart than either clay or sand; for which it is favourable to the process by which organic matter buried deep in the soil is converted into *insoluble humus;* it also permits that part of it which is nearer the surface, to attract *oxygen* from the air, and thus it is converted into a *soluble extract*, which is to the roots of plants what the *milk of animals* is to their young —or ready-made food easily converted into vegetable juices.

The mineral elements of soils become parts of plants. *Life modifies chemical laws, and converts inorganic matter into organic.*

The fertility of a soil is dependent on other things besides its chemical composition. We must consider the office it performs is two-fold, namely (1) to retain the plant firmly in the position most favourable to its growth, and (2) to supply a certain amount of food. Hence *mechanical texture* becomes a matter of great importance; it must be *firm* enough to afford the proper degree of *support*, and at the same time *loose* enough to allow the delicate fibres of the rootlets to extend themselves and also access of air to take place, without which the plant cannot live. It must be of such a texture as to retain, for a considerable period, the water which falls on it and at the

same time *porous* enough to suffer the excess to *drain away:* otherwise the roots of the plants will rot. It is for these reasons that the nature of the solid substratum at some depth beneath the soil must be borne in mind. These and other things, such, for example, as the condition of the surface with respect to its *absorbent* power for heat, all tend greatly to complicate the subject, and render decisions concerning the comparative value of different lands, founded on merely chemical evidence, exceedingly prone to error.

The great essential principle to be sought for in manures is this great law of nature, that *substances strengthen vegetation mainly by their contents of nitrogen.*

In *dung* and in *liquid manures*, the *nitrogenous* matter is partly combined with *hydrogen*, and has thus become *ammonia.* Farm-yard dung contains *all* the principles withdrawn from the soil by the growth of plants: the decomposed *straw* furnishes *silica* in a minute state of division, still having with it a little *potash* and various *saline* substances. The *solid animal excrements* contain abundance of earthy *phosphates*, while the *urine* gives up by its putrefaction at once *carbonate of ammonia* and *more phosphate*, besides smaller portions of other principles. The only thing at all *defective* is *potash*, and that frequently exists plentifully in the soil, and is gradually liberated by disintegration.

Solid animal manures should not be allowed to putrefy in heaps *above ground*, because a great portion of the manuring matter, in that case, assumes the *state* of *gas*, and is *wasted.* In the heap, previous to fermentation, the nitrogen, the essential element of ammonia, and of supreme value to the planter, is variously combined with carbon, oxygen, and hydrogen; but when it leaves its former arrangement, in obedience to the action of decaying bodies, it uniformly adapts one and only one, new one. *Every nitrogenous compound exposed to air and moisture liberates its nitrogen to unite with free hydrogen and form ammonia.* This is a *principle of fermentation* which admits of no exception. The true economy of farm-yard manure may be thus indicated; *nothing must be allowed to run away in the form of a fluid, or to fly away in the disguise of a smell.* Therefore we must store the dung daily in proper pits under shelter.

The cow-sheds, of whatever material the walls and roof may consist, as long as ventilation is ensured, must be floored with *pucca* terrace flooring, paving stones, tiles, bricks, concrete, and Portland cement, or planks, and must have a gentle slope towards a gutter running down the centre. In this manner not a particle of dung or drop of urine and *washings* can run to waste. At a convenient distance, though as close as possible, let the manure pits be made. The best plan is to have the manure shed parallel to the cow-shed, on the slope of a hill, immediately above or below it. The pits, arranged side by side, should if possible be floored and lined with masonry, if not possible with hard moss, being previously well puddled. They should be made as water-tight as possible. The cowherds should daily collect the dung and litter, and spread it evenly in a pit, also spreading a few inches of *dry* earth, of which a heap should be collected and stored in an adjoining shed in dry weather, over the mass, then tread it well down. The gutter, running down the middle of the cow-shed, should either be connected with the manure shed or end in a spout, under which tubs or large earthen bowls should be placed. The urine

and washings, thus collected, should be poured over the dung and litter previous to the dry earth being stamped in. If no litter is used, any grass will do, though paddy straw is the best. When one pit gets filled up with these daily layers of dung, litter, and earth, cover all up with another good layer of earth and turves, and commence filling up the next pit. These pits should be *emptied* in the *same order* they are *filled*, and only *wooden* rakes and implements should be used.

Every description of sweepings, stable litter, elephant's dung and litter, and all the ashes from the factory and coolie lines, should be carefully collected and immured in the manure pits along with the dung from the cow-sheds. Dead bodies of animals, and excrements objectionable to the caste prejudices of the coolies, can well be disposed of by being burned anywhere about the plantation, among the bushes, with a good sprinkling of *lime* if possible.

We must now glance at some manurial substances, always at the planter's command, where farm-yard manure is not procurable at all or in too insufficient quantities to be of any good—*Ashes*, *Lime*, *Guano*, *Superphosphate of Lime*, *Salt*, *Oil-cake*, *Aquatic plants*, and the *mud* of *jheels*, *bheels*, *tanks*, and *ponds*.

Ashes.—The really enormous amount of this valuable manure daily prepared in the factory, engine-house, cook-room and, last but not least, coolie lines, and, generally wasted or frittered away, is lamentable on most plantations. Every particle of ash should be carefully collected, stored along with the charcoal dust and sweepings of the charcoal godowns in a convenient, *water-tight* shed, for manurial application during the cold season. All the wood of the tea prunings should be gathered and burnt in bare patches all about the plantation, and applied to the neighbouring bushes. This is really *returning the actual elements* of which the tea bush is composed. *Lime* is abundant and cheap in some tea districts, as Sylhet, Cachar, and the Darjeeling Terai, and is a most valuable manure. Soils and sub-soils, far below the reach of ordinary cultivation, always contain a very sensible quantity of *ammonia*. The action of lime, in the presence of water, is to set free from the soil as nearly as possible one-half of the ammonia. The application of lime on cold, spongy, marshy soils is most profitable. The chemical action of lime, and the effect which it produces as a manure, appears to be of two kinds. On the one hand it acts upon vegetable mould, accelerating its decomposition and rendering it soluble, and then fits it to enter the roots of plants. Lime deprives some mould of its *acidity*, and renders it fertilizing. But, on the other hand, there is every probability that, by means of its *carbonic acid*, lime produces some other effect, and furnishes the plants with some nutritive matter. The roots of certain plants, especially tap-rooted ones like the tea plant, appear to have the faculty of depriving lime of its carbonic acid, which it immediately *re-absorbs* in equal proportion *from the atmosphere*,—boring through limestone in its hunger for lime.

Guano.—The chief mineral constituents of plants—*lime*, *magnesia*, *soda*, *chlorine*, *sulphuric* and *phosphoric acids*, the latter—the most important—are found in guano. *Nitrogen*, the most valuable constituent of manures, is also found in guano in great abundance. This substance, guano, is the excrement of sea-fowl, and was used as manure by the natives ages before Peru or South

America was visited by the Spaniards. The value of guano is to be estimated according to the proportions which it contains of (1) Ammonia, (2) Phosphates, (3) Organic matter. African guano has the largest proportion of soluble matter, and that from Peru is remarkable for the quantity of *uric acid* that it contains,—an element which dissolves very slowly. *African* guano may therefore act with greater *rapidity*, but the effect of *Peruvian* guano is *felt for a longer period.* If we take the percentage of nitrogen as a correct indication of manuring value, we shall find that—

One ton of Guano
$=33\frac{1}{3}$ tons farm-yard dung.
$=21\frac{1}{2}$ tons horse dung.
$=38\frac{1}{3}$ tons cow dung.

Let those who plant in hilly countries and places where carriage is expensive, ponder well the above facts.

Guano being very energetic and stimulating in its action, should invariably be mixed with five or six times its weight of ashes, turf, mould, charcoal dust, or fine soil, previous to being applied to the tender rootlets of the plant. The fresher guano is the more valuable and lasting. *Superphosphate of lime* or bones treated with sulphuric acid is a very valuable manure, combining as it does the earthy matter called phosphate of lime and sulphuric acid, which unites with and retains the volatile and valuable ammonia of sulphur, and yet, while fixing it, in no degree diminishes its solubility. The sulphuric acid used in forming superphosphate of lime unites with the base, lime, and thus forms a salt of immense agricultural value. The finer and fresher the superphosphate is the more immediate are its results. Superphosphate of lime applied in conjunction with farm-yard dung, is the perfection of manure. Such an application need be made only once in three years. About twelve hundredweights an acre, or about half a pound to each of the 2,722 plants ($4' \times 4'$) in the acre, is a fair allowance, with at least 10lbs. of farm-yard dung to each bush. *Salt (chloride of sodium)* being a direct constituent of plants, is a valuable fertilizer. Salt stimulates the organs of plants to more active vegetation. It promotes the decomposition of the animal and vegetable matters of the soil. It prevents evil effects from changes of temperature. It causes the soil to attract more moisture. It destroys vermin and weeds. *It prevents mildew, and helps to eradicate blight.* All plants take up salt with the greatest avidity; and if the Government of this country could only be made to see through the spectacles of the German Government, and allow methylated salt, unfit for human consumption, though not *unclean,* to the caste prejudices of the natives, to be sold for a nominal figure, such as it is sold for out of the salt ships, to agriculturists and planters, it would be conferring a far greater and more real boon, than by the creation of agricultural and statistical and irrigational *et hoc genus* directorships. The sour, exhausted, ill-cultivated fields of India would, if each had a tongue, cry with such a lamentable howl for salt, as would drive the Government and its empirical advisers into a fit—of sense. *Oil-cake,* the solid refuse of oil-yielding seeds, from which the oil has been expressed, affords a very fertilizing manure, as it contains a large amount of *nitrogen.* One ton of oil-cake affords about as much nitrogen as *ten* of farm-yard dung. It is also greatly *superior* to farm-yard manure in soluble *organic matter,—equal* in *phosphates,* though

inferior in *saline matter;* hence the advisability of using oil-cake *in conjunction with salt.* As, however, the manurial effects of oil-cake are *not lasting,* it is more valuable as a tonic and stimulant to heavily pruned or diseased plants, in conjunction with high cultivation, than as a regular article of plant-food.

Aquatic plants, in most tea districts, afford a most abundant and annual supply of manure that can be obtained at the cost of collecting. Dug into trenches during the cold weather, deep-hoeing by the men, while the women and children can gather these plants from neighbouring sources, is so obvious a method of supplying *potash* and *humus* to tea bushes, that one wonders how few planters use these desirable water plants.

In opening the soil round about a plant to manure it,—for it is little use placing the food, manure, beyond reach of the mouths, the rootlets,—no other implement but the hand or digging fork should ever be used. It is marvellous how people are stupid enough to chop up the feeding roots with a cutting instrument such as *khodales!* Old men, women and children, unable to dig or prune, can best be utilized in opening up the soil a foot all round a bush to a depth of five or six inches, with a hand fork; laying in the manure and covering up instantly. It is unnecessary and harmful to open the soil and expose the tender roots for days and weeks before the manure is applied. To ensure a supply of farm-yard manure it will be incumbent on the planter to keep his own cattle. This may be thought an expensive way of getting manure, but any one giving this subject of renewing the fertility of the soil of his garden, after years and years of *taking* and *no returning,* must perforce admit, that measures, at no matter what cost, *must* be taken to prevent the falling off in quality and quantity. For there can be no doubt that it is only the young plant coming into bearing that is keeping up or increasing the annual produce of most gardens. Large areas of comparatively scant production to what could be attained by the use of manure, cannot possibly pay, if we consider the one item,—*cost of importing labor* to most districts.

A large herd of cattle can alone supply the enormous quantities of manure annually required in a plantation, say of 300 acres. The miserable stuff, of itself poor in manurial elements, and further ruined by reckless exposure and ignorant treatment, obtainable only in favored localities by purchase from surrounding villagers, is much too insignificant a source to rely on solely. On the lowest estimate the dung of eight cows or bullocks are required to manure an acre. For, assuming there to be 2,722 plants in an acre (4′×4′), and allowing the moderate quantity of only 5 seers or 10lbs. per acre, we require 2,722 ×10lbs.=27,220lbs.=340 maunds an acre. The produce of a single animal will not amount to much more than 10lbs. per diem of manure, or 45 maunds per annum, and consequently we want eight or nine head of cattle to supply this amount, *viz.,* 340 or 350 maunds per acre. We see, therefore, that to manure a 300 acre garden only once in three years, or 100 acres a year, the manure of 800 head of cattle is required annually. This seems an enormous herd, and, at 20 rupees per head, would cost 15,000 rupees to buy. However, *it may be managed.* Suppose there are 300 coolies employed on the plantation,—one coolie per acre: this would represent about 125 to 150 families. *Advance* each family

the money to buy a cow and calf, the amount being realized by monthly instalments of one rupee, or recovering two-thirds the advance in cash, and taking the *weaned* calf for the remaining third. In this way there would be about 300 cows and calves on the estate. Buy 300 cows yourself,—on ehundred annually. In a few years there would be cattle enough and to spare. The thing is to *forestall* poverty of the soil, by commencing to manure as soon as the bushes begin to give a *full* crop, that is, at five years old. If a comparatively small herd of cattle is purchased at the *opening out* of a garden, there will be quite enough cattle to supply the needful quantity of manure in the fifth year.

However, manure is not the *only return* from this herd. The *ghee* and *bullocks,* annually sold, would amply pay the interest on the capital expended, and provide funds for the *feed* and keep of the herd. *For cattle to produce decent manure, the animals must be decently fed.* In addition to grazing, the cattle must have a feed of *chopped paddy-straw* (an article that would cost little or nothing), and *oil-cake* every evening. If oil-seeds are grown in the district, buy and crush your own oil and cakes. The sale of the oil will more than pay all expenses.

15.—DRAINAGE.

DRAINING is an operation the less a plantation requires the better. As has been already remarked, the tea industry must not be handicapped by expensive expedients being necessary to the full development of the plants. *Draining,* or the reclaiming of land from too moist a condition, is necessarily a tedious and expensive work, requiring no small amount of engineering knowledge and capital. And that the results amply repay the capital and skill applied to the carrying out of such reclamation in densely populated countries, where money is abundant and arable land scarce, cannot be doubted. But that tea should not be grown, and will certainly not *pay* under such circumstances, is equally certain.

However, it sometimes unhappily happens that a portion of a garden has been planted on marshy land, or in a situation exposed to inundations, either from neighbouring streams or excess of rain water. In such a case, rather than abandon the plot, or allow the plants on it to sicken and die off, it may perhaps be better to attempt some simple expedients to correct the initial blunder. The first thing to do is to get an accurate idea of the *lay* or *gradient* of the land; the next thing is to discover the *cause* of the superabundant moisture, which is not always obvious. The triangular wooden level used by native masons, and some flat-headed pegs, will materially assist in ascertaining the slope of any piece of land. Supposing that the land is *marshy,* it is so either from its low situation, causing it to receive and *retain* water from surrounding country; or from the presence of *internal springs,* without any suitable channels of escape. If the humidity of the soil is caused by the stagnation of water from surrounding hills or high lands, the first thing to be ascertained is, whether or not a canal, the bottom of which shall be on a level with the marsh, can be dug on the declivity of the high land, to prevent the water from over-running the soil. If the marsh is *surrounded with hills,* the remedy consists in finding an outlet for the water

through one of the inferior strata of the soil; but success in this will depend upon whether the marsh is *above* the level of the nearest river or pond. If the dampness arises from *springs,* the essential point is to discover the level or height at which these break out. Sometimes they show themselves at the edge of the marsh, in a position rather higher than the spongy earth. When in this position, they may be carried off by a drain, or by sinking small wells, so as to expose the springs and dry them up. However, if the springs are at the bottom of the marsh, there is nothing that can be done but to form a large drain for carrying off the water across the marsh.

In any case, if water lodges at the roots of the plants, either from internal soakage, as in marshy land, or from the rain water, unable to drain freely off, or sinking, a system of surface drains are necessary,—and the *only* remedy at the planter's disposal.

Having found the *lowest level* of the plot, and the *direction* in which this level tends, cut a drain, half as deep again as it is wide, along this lay, until it becomes the tributary of the nearest large water-course. Let the course of this main drain be *as straight as circumstances will permit,* avoiding all sharp and small bends, but following the line of *natural drainage* as closely as possible. Having provided the channel for carrying off the superfluous water, a regular system of arterial drains must be provided to collect this water, and lead it to the main drain. At regular intervals cut drains down the middle of the spaces between the rows of plants, to meet the main drain. The mouths of these side drains must always be *higher* than the bottom of the main drain, and must always point *down-stream;* for, were the side drains pointing *up-stream,* the collected body of water running down the main channel would flood the lower side drains, and thus increase the mischief sought to be repaired. In cutting the main drain the earth excavated should not be piled along the edge, so as to form *bunds* or embankments hindering *surface drainage,* but spread evenly to same distance on either side. These drains, especially the main one, will constantly be *silting* up and *scouring* at the sides. A gang of men should be steadily employed to clean out the *silt,* which will generally be the finest and richest silt of the surrounding soil, and hence not to be wasted, but spread among the neighbouring bushes. To prevent *scouring,* cut the sides of the drains slanting down from top to bottom, and, if possible, turf the sides or encourage grass to grow on them.

Every time the tea fields are hoed, the smaller drains down the lines should be dug out in the regular task given the coolies. It may at the beginning be necessary to open a drain down every line, but intermediate ones may be gradually abandoned.

The earth dug out of the smaller drains should be spread *evenly* round about the plants. Heaping earth round the stems above the collar is a most injurious practice. If surrounding jungle is cut down and laid in trenches between the rows of plants, and covered over with earth, a large amount of *humus* is prepared, and the earth kept open and dry,—a very desirable result in heavy clay soils. This should be done in the first hoeing *after* the rains, and the opposite process of excavating the drains immediately *before* the following rains. Thus the manifold advantages of draining, trenching, and manuring, are

secured in one operation, and with least cost of time and money. Each marshy patch should be individually treated, and have its own system of drains, though all the main drains, in one divsion of the garden, may converge towards and empty themselves into the same water-course.

Should any portion of a plantation be unhappily liable to periodical inundations by neighbouring streams, it will be necessary to embank the stream. Generally two embankments will be necessary,—one parallel with the stream, and another at an angle, on the up-stream boundary of the garden. Proportionate to the volume and rapidity of the stream, a ditch should be dug parallel to the stream, but a certain distance from wet weather high-water mark. The excavated earth should be filled up, to form a *bund* or embankment on the strip of land left undug between the stream and the ditch. On this, ramp grass should be encouraged, and on the river slope aquatic plants, like willows, should be planted, to bind the earth of the *bund* firmly with their interlacing roots. The ditch should, *when quite clear of the plantation*, open into the stream, and thus discharge the rainfall of the unbanked area.

It should never be forgotten, that *stagnant water is one of the deadliest enemies of the tea plant.* Its presence is invariably indicated by the yellow, stunted, debilitated appearance of the bushes and the abnormal abundance of seeds on their branches.

There is only one alternative to *draining* a plot of tea, and that is *abandoning it*, for it will never give a remunerative yield—even if it does not die out.

The more an earth weighs, the greater is its power of retaining heat. The darker its color, and the smaller its power of retaining water, the more quickly and strongly will it be heated by the sun's rays.

The greater the power of containing water, the more has it in general the power also of absorbing moisture when in a dry, and oxygen when in a damp state, from the atmosphere.

When endued with a high degree of consistency, it is slow to become dry.

The greater the power of containing water, and the greater the consistency of a soil, the colder and wetter, of course, will that soil be, as well as the stiffer to work, either in a wet or dry state. Coldness in retentive soils is caused chiefly by the removal of the water of drainage by evaporation. That the evaporation of water produces cold is well known :—it cools wine ; in hot climates it produces ice.

Humid soils are little benefited by summer heats, because water, in a *quiescent state*, is one of the worst conductors of heat with which we are acquainted. Water warmed at the surface transmits little or no heat. The small warmed portion expands, becomes lighter than that below, and consequently, retains its position upon the surface, and transmits no heat underneath. When water is *heated from below*, the portion first subjected to the heat, rises to the surface, and every portion is successively subjected to the heat, and rises, and each having lost some of the heat at the surface, is in turn displaced. Constant motion is kept up, and a constant approximation to an equal temperature in the whole body.

Drainage elevates the temperature of the soil, because, by removing the water of drainage, it prevents that constant evaporation by which the surface heat is lowered.

But it also acts in another way ; many experiments have shown that

in retentive soils, the temperature two or three feet below the surface of the water-table is, at no period of the year, higher than 46° to 40° in agricultural Britain. Drains placed two or three feet below the water-table, draw out water of the temperature of 48°. Every particle of water which they withdrew at this temperature is replaced by an equal bulk of air at a higher, and frequently at a much higher, temperature. *The warmth of the air is carried down into the earth.* The temperature of the soil, to the depth to which the water is removed, is in course of constant assimilation to the temperature of the air at the surface.

Lavergne, in his "Rural Economy," says: "Take this flower-pot:—what is the meaning of this small hole in the bottom? to renew the water. And why renew the water? because it gives life or death: life when it is made only to pass through the bed of the earth, for it leaves with the soil its productive principles, and renders soluble the nutritive properties destined to nourish the plant. Death, on the other hand, when it remains in the pot, for it soon becomes putrid, and rots the roots, and also prevents new and nutritive water from penetrating." *The theory of drainage* is exactly described in this figure.

PART III.—MANUFACTURE.

16.—Arrangements of Factory.

Considering what quantities of good tea have been made in huts that could hardly be dignified with the name of factories, this chapter may, on first sight, seem superfluous. But as this industry is gradually casting off the slough of semi-barbarous methods, or rather want of method, and taking to a more rational procedure than the happy-go-lucky style of the good old days, it is only proper, that the planter put his tea-house in order before commencing manufacture.

Building, with no matter what materials, is generally a troublesome and expensive operation; therefore, if possible, accumulate the trouble and expense, and have done with buildings at the very outset.

The most suitable roofing material is undoubtedly galvanized corrugated iron sheets, and when these are ordered from the manufacturers' direct, and imported in sailing vessels viâ the Cape, as all tools and stores should be, without the kind intervention of numerous middle-men, with their fearful and wonderful percentages, the cost is really very moderate. The eternal repairing and constant risk attendant on thatched and even shingled roofs, make any but iron roofs most undesirable.

The walls may be built of reeds (*ekara*), bamboos, planks, mud, sun-dried or *pucca* bricks, stone, or best of all corrugated iron, according to the district and climate.

The timber used should be of two descriptions: one that will not rot or eat if buried in the ground, for posts, &c.; and the other light and, if possible, impervious to the attacks of borers and other insect pests. The wood used in contact with the ground should previously be well charred, tarred, creosoted or coated with crude earth-oil or silicate paint. However, tar is a dirty, sticky material to use in a tea-house. Unless timber is quite dry or seasoned, it will rot or eat if buried or coated with any of the above; and will soon become like sodden tinder.

All nails used should be either *wrought* or those known as French pins (pointes de Paris). The former for heavy timber, the latter for planks or battens.

Plank flooring should never be *nailed*, but always *screwed* down, the screws being previously *oiled*. These can be easily removed, while those corroded by damp, or by the sap in the timber itself, are very difficult to remove, and entail destruction of the plank. Unless planks are thoroughly seasoned, it is as well to fasten down the flooring with thin battens running over the pins, screwed down every here and there.

The panes of glass used for doors and windows, should be of uniform size, 12″ × 10″ being the one most useful. The putty should be English made, and not the abomination concocted by natives, that soon dries and drops, leaving the panes to follow suit on the first windy day.

Silicate paints are undoubtedly the best and most economical in the long run. Woodwork, previous to being painted, should be washed clean with a little crude soda (*Sájí matí*), warm water and a stiff brush. Old painted wood, before being repainted, should always be so cleaned, or the new coat is sure to blister off, having no real hold on the smooth surface, but on a blistered coat of old paint, with a layer of dirt in between the old and new paint. None but the best English boiled linseed oil should be used in mixing paints. Never buy *dry* paints. If turpentine is used, it gives the painted surface a dead look, while if only oil is used, the result is a gloss. Bundles of rags used instead of paint brushes cause waste.

If the factory is to be built of wood, iron, or masonry, all the materials should be sawn, dressed, ordered or prepared *the year before*. When the actual building is put in hand the lack of materials should be the last cause of stoppage or even temporary delay.

In planning a factory, a most important consideration is the *site* with reference to (1) water-power available for driving machinery, (2) proximity to the bungalow and coolie lines, (3) the soil in which the foundations are to stand. The next point to consider is the *maximum yield* of the garden. And, lastly, the prevailing winds during the manufacturing season, as well as the climate of the district.

Suppose the best available site selected; the climate that of the plains, hot and moist; the prevailing winds during the rainy season S. W., and the maximum outturn expected a thousand maunds. A factory 150 feet long and 30 feet wide, with one *end* facing S. W., is what is required.

For financial or other weighty reasons it may be convenient to build the factory by instalments. This can easily be done, as a factory must be divided into three distinct compartments of equal size for *rolling*, *firing* and *packing*.

Commence with the S. W. end first. Mark out a square 50 feet each way. If the walls are to be of masonry, foundations must be dug down to the lower solid stratum, at least three feet down. Along the lines marking the square place pegs every 12′ 6″. Round about these pegs, as centres, dig a hole 2′ 6″ square, and at least 3′ deep. Connect these square holes with each other by trenches 1′ 6″ deep and 1′ 6″ wide. Fill up all these holes with masonry, building up to about a foot above the general level of the ground. We have now the *plinth* ready. Run up the pillars, 2′ square, and the connecting walls, 1′ wide, to a height of 10′ all round. The door frame (*chowkut*) 8′ × 6′ should be placed on the plinth and built in between two of the pillars of the

N. E. wall. A window frame (6′ 8″ ×4′ 3″) should be put in position, exactly in the middle, when the connecting walls are 1′ 6″ high, between every pair of pillars along the S. E., S. W., and N. W. walls.

On the completion of the pillars and walls, on a uniform height of 10′, being attained, wall plates of timber, in lengths of 25′×10″×3″ *halved* into one another, should be laid along the S. E., S. W., and N. W. walls. Care should be taken that these *plates lie exactly in the centre of the walls,* so that the *entire wall supports the weight of the roof.* However these plates are generally placed on the *outer edge* of the wall, thus throwing the *entire thrust of the roof on the few outside bricks only,*—a most unnecessary and dangerous practice.

Exactly in the centre of the room, to be ascertained by stretching two cords tightly from the opposite corners, make a hole, six inches wider than a good slant (12″) post, 15′ high. Fill the bottom of the hole with 6″ of charcoal, well rammed down, put in the post and pack it tightly with small charcoal, well rammed all round. A post so secured in the ground is utterly impervious to the attacks of white ants, &c., who cannot bore through well founded compact charcoal. In fact charring or surrounding wood with charcoal is the only efficient method of preserving it from insects and damp.

A cleft, 3½″ wide should be made, 9″ deep, at the top to receive the ridge pole 26′×9″×3″. The N. E. wall should be continued up in a a triangle, the apex of which should be the exact height of the post in the centre, *viz.,* 15′ above the plinth. On this apex, a corresponding cleft being left in the masonry, the other end of the ridge pole will rest. Two other ridge poles, morticed into the head of the post, and resting on the S. and W. angles of the wall plates, projecting 2′ 6″ beyond the pillars, will complete the outline of the roof which will have three slopes, facing S. E., S. W., and N. W. respectively. Rafters (9″×3″) must next be secured to the ridge poles, parallel to and 12′ 6″ from one another, and at perfect right angles to the ridge poles. The rafters should project about 2′ 6″ beyond the walls, to form the eaves.

Fill up the angles formed between these rafters and the wall plates with triangular blocks of wood, which being cut to fill the angle exactly, will give a bearing surface of the entire width of the wall plate. Drill a half inch hole perpendicularly through the rafter, chock, and wall plate. Raise the entire mass of timber, slip a half-inch bolt, fitted with a head and nut, up from the under side of the wall plate, and putting on an inch and a half iron washer, screw down the nut tight, so as to connect rafter, chock, and wall plate in one solid mass of timber. Similarly drill a hole through an opposite pair of rafters and the intervening ridge pole, and with a bolt and nut bind all three firmly together. Nailing the timbers of roofs together with huge spike nails is a clumsy, insecure and destructive device. If bolted together, an entire roof can be tightened up or taken to pieces at pleasure with ease. Should posts be used instead of pillars, the hardest wood procurable, ironwood if possible, should be used. The head of the posts should have notches cut in them to hold the rafters, which should be keyed into them with an iron pin,—a piece cut off ½″ rod iron, not a nail hammered through, generally splitting the cheeks of the notch. Pillar plates are not necessary unless the rafters are placed closer together than the posts. These plates should be let into the posts on the outside just below the bottom of the notch. A band of iron should

be nailed under the pillar plate, passed over the rafter and nailed under the plate. To dig a hole in the side of the rafter and nail it down to the pillar plate is very clumsy, and affords little or no hold.

The spaces between the posts can be filled in with matting, planks, or, best of all, corrugated iron, fastened on battens exactly like the roof. This makes a very clean, lasting piece of work.

Beams should seldom or never be let into or nailed to posts: cutting notches in posts weakens them considerably, and can generally be avoided by using *brackets*. These are blocks of wood fitted with a slot or notch, a trifle larger than the beam to be rested in them, nailed on to posts or beams. In supporting beams across from one row of posts to another, nail brackets on to the inner face of the posts, with two large spike nails, and in these brackets place the beams which should be one inch shorter than the exact distance between the posts, to allow them free play. In case of the beams sogging, or bending down into an arc from their own or the superincumbent weight, the floor can be raised sufficiently to allow of the beams being lifted out of the brackets and reversed. This simple way of correcting a serious fault in a floor could not be possible without much labor and more destruction were the beams and planks nailed down. Tie rods and sheets are also useful in preventing the rafters sogging. The consequence of this fault in roof timbers is gaping of the sheeting or shingles and leakage. Sheets may be placed under a beam likely to sog, until the fibre of the wood has stiffened. Sheets should have a cleft head in which the beam rests, otherwise they are apt to fall away when the beam above vibrates from any cause.

When the rafters have been firmly fixed in their places, if 6-inch sheets of iron are to be used, eleven parallel rows of battens (3″ × 3″) should be nailed into notches, half an inch deep, across each slope of the roof.

Commencing with the lowermost row of sheets, *screw* down four rows. Then, if thorough ventilation is desired, *bolt* down the topmost row of sheets so as to have them 6″ higher than the other lower sheets. This can be done by using blocks of wood six inches high for the bolts to pass through at the ninth batten and proportionately high ones at the tenth batten, while the ordinary screw can be used at the topmost row. The sheet so raised must be a foot longer than the others, *i.e.*, it must be a 7′ one. Six sheets on either slope, with an additional one, so as to give an overlap on the sides, will, if thus raised, make a very efficient ventilator if one such is placed over each of the three rooms of a factory.

Wrapping a piece of jute tow, dipped in thin lead paint, round the shank of a screw, below the washer, plugs up the hole punched in the iron, and makes a very water-tight roof. Care should be taken to punch the holes on the ridges, and not in the gullets of the iron, and to use a backing of half round wood, as the iron gets dented in and the hole is not a clean one. No amount of cobbling and tinkering will make a badly put on roof watertight, and as a little European superintendence is all that is required to make a tight roof, there can be no excuse for having a leaky one.

The windows, which are frequently left *unbolted* either from carelessness or design, for there is a great deal of petty pilfering invariably going on in a factory, should open inwards and be guarded by iron wire netting, inch mesh, such as is used for fences and aviaries at home.

The walls should be well plastered and painted with silicate paint. Unprotected walls suffer from damp, and the bricks and mortar soon crumble away.

The floor should be beaten solid; covered with a three-inch layer of concrete, and finished off with Portland cement. In using this cement the following should be observed to ensure good work :—(1) Use the heaviest description of cement procurable, *quite pure*. Mixing and ekeing out with sand is false economy,—in India at least. (2) Use as little water as possible in mixing for use. (3) Lay it on in as thin a layer, and as quickly as possible. (4) When dry enough, flood the floor with clean water and keep it so as long as possible. The slower cement sets under still water the tougher the work done. (5) Cement should not be used in the immediate vicinity of fires, as it invariably blisters and breaks up.

The complete factory should consist of three rooms, for rolling, firing, and packing, each about 48′ square. The N. E. room should be for cleaning and packing, as the one with the best aspect for light. The windows of this room, instead of being high and narrow, should be about 4 feet high, and fill up the entire space between every two pillars. The entire window should be in one piece with the hinges on the top side and kept open, in a slanting position, *outwards*, with two long iron hooks. The floor of this room should be well cemented, and the walls painted with white silicate paint, if no other room in the factory is. The bins raised off the floor on *wooden* legs, and a foot away from the nearest wall, should stand with their backs to the partition wall, on the left hand side of the door. Every 10 feet of bin should be fitted with a trap and sliding door, on the top and front, as low as possible.

The next or middle one should be the firing room, and in the S. E. wall of this room should be the *one* outlet and inlet of the factory, the doors leading into the two other rooms being also immediately to the right and left of the entrance. This room should be furnished with *pucca choolas* round the three other sides. Each side will accommodate twelve *choolas*, thus giving a total of thirty-six. Down the centre there should be a high, long table about 3′ 6″ wide. The *chalnees* or trays used for firing should be in racks between the legs of this table; while the top used for charging and turning the *chalnees* during firing. In convenient spots zinc-lined boxes, with traps in the lid, and chain, and padlock, should be placed, raised off the ground, one for each of the four tea makers. As the tea is dried it is tipped into the box, which is opened, and its contents weighed *by the Assistant* next morning. The result of one man's careless firing is limited in mischief, and robbery prevented. The floor of this room should be tiled, paned or planked, so as to stand the necessarily high temperature. If planked, the plinth of the *choolas* should extend into the middle of the room for two feet, to prevent the planks catching fire from stray pieces of lighted charcoal. Covering a planked floor with tin or iron, to guard against fire, only *conceals* the mischief until the conflagration is serious enough to betray itself.

The rolling room should be provided with a long narrow table on which lots of leaf should be arranged in the precise order in which they were rolled, by nailing a ledge, four inches high, round the edge of the table on three sides, and dividing the space so enclosed into

a convenient number of divisions, each big enough to hold one feed of rolled leaf. The other fittings of this room will altogether depend upon the use of machinery or the hand for rolling. In any case one rolling table will be required to give the finishing hand-roll which so improves the appearance of machine-rolled tea. This and all other rolling tables should be heavy and strong to stand the jerks, shoves, and general violence of twenty rollers all round it.

No broom should ever be allowed into a factory. Nothing but swabs, wetted sufficiently to gather the dust, instead of making it and ashes fly all about the place, covering every inch of wall, timber and roof with a thick coat. Every ounce of tea contains a certain amount of ashes and sand, if nothing worse. The former gives the tea a bad flavor, though it may in some measure act in *drawing* the infused tea. However, it would be much more profitable not to *adulterate* our teas with *dirt*,—the result of thoughtlessness. The factory should be swabbed every morning and evening, and the walls and roof timber brushed and cleaned at least once a week, on the non-manufacturing day.

Heavy articles, such as kegs of paint and nails, and boxes of lead and solder, should not be allowed into the tea-house, as their introduction leads to destruction of the floor and walls.

A proper tool and store room, fitted with racks and shelves, should adjoin the factory. This building should be fire-proof, damp-proof, insect-proof, and thief-proof, by being built of iron or masonry with a concrete floor raised a foot above the general level of the ground. There should be at least two or three small windows, glazed and protected by wire netting.

TEA CULTIVATION.

PART I.—PLANTING.

TILLAGE.

TILLAGE, applied to arable land, is the stirring and preparing of the surface of the soil, so as to render it fit for the vegetation of the seeds committed to it: its object also is the destruction of noxious weeds.

The whole art of cultivation consists in tillage and manuring, and the profit of the husbandman depends on the perfection of the tillage and the economy of labour in producing the effect. A defect in tillage will cause a great deficiency in the crops in ordinary years. To ensure good crops, the soil should be in such a state that the rains and dews may readily be diffused through it, without giving it a wet appearance, or evaporating too rapidly. It requires great knowledge and experience to give any particular soil the exact portion of tillage which is suited to it. A fine garden-tilth, as it is called, is the most perfect for light soils which have been long cultivated and manured; when they can be brought to such a state that after continued rains the surface dries without forming a crust, and crumbles of its own accord, the tillage has been good; and the deeper this soil is stirred, the more it will produce: but where clay abounds in the soil, which in dry weather can be readily pulverised by crushing the

dry clods, and be reduced to the finest powder, too much tillage may do more harm than good. The fine clay is soon converted into mud at the surface by the least rain, because it is not sufficiently porous to let the water through it; it dries into a hard crust, which effectually precludes the access of air, and consequently stops the vegetation of the seed. It is only by abundant manuring with organic matter, especially of animal origin, that this natural tendency in clays to cohere can be overcome; and until this is effected it is best to stir clay soils as deep as possible by means of subsoil-ploughs, but they should not be pulverised so that the water cannot run down between the lumps and clods, and especially the surface should be left in such a state of roughness that heavy rains cannot cover it with a coat of mud. The clods which are left on the surface imbibe the moisture more gradually, and in drying fall to pieces, by which the young plants are invigorated, and, as it were, moulded up. This is particularly the case in winter after a frost, as all clay-land cultivators are well aware. It is very easily ascertained whether a soil will bear much tillage or not. It is only necessary to try some of it in a large pot or box; make the surface very fine by breaking the clods, then water it abundantly, and let it dry in the sun: if a crust is formed in drying, that soil will not bear too much harrowing and pulverising, and should be left in a moderately rough state after sowing or drilling the seed; but, if after it dries, the surface is loose and porous, then the finer the tillage the better the seed will vegetate. The whole depends on the ready admission of air or its exclusion. Some plants will force their way through a very hard surface; but small seeds are too weak to do so, and their growth is entirely stopped by the least crust on the surface. Besides the preparatory tillage of the soil before sowing the seed, there is a great advantage in the stirring of it as the plants are growing. On this depends all the merit of the row-culture for every kind of plant, especially those which have esculent roots or extensive foliage. As tillage can be increased by mechanical contrivances where labourers are scarce, whereas the supply of manure must generally be limited, it follows that, as a general rule, the land should be well and deeply tilled, due attention being paid to the nature of the soil and its property of retaining or transmitting moisture. Very loose sands should not be much stirred until they are consolidated by the admixture of marl, clay, chalk, or well-rotten dung; but in all cases the manure should be mixed as intimately as possible with the soil, and as deep as the tillage has gone, not including the stirring of the subsoil; for the roots will always penetrate thus far and find the nourishment which they require. Those plants which throw out roots from the bottom of the stem, require the surface to be most pulverised and enriched to allow these roots to spread, and where land is clayey and contains the mineral food of plants, sufficient tillage is all that is needed for constant cropping, annually from the same field. Spring tillage is highly advantageous; this is found to give much finer crops, from the circumstance that the hoe not only loosens the earth between the rows, but also between the different patches of the growing plants by which the coronal roots are much strengthened. The crowding of several plants does not prevent their growth, provided the fibres can spread around in a rich mellow soil, well pulverised, and admitting the air and moisture readily.—*English Cyclopædia.*

SOIL.

WHEREVER the surface of the earth is not covered with water, or is not naked rock, there is a layer of earth, more or less mixed with the remains of animal and vegetable substances, in a state of decomposition, which is commonly called the *soil.*

The nature and composition of the

soil, and consequently its greater or less aptitude to the growth and maturity of vegetable productions, depend on the composition, the proportion and the mechanical structure of the various substances of which it consists. When the soil is favourable to the chemical action by which the elements are combined to form vegetable substances, and admits that quantity of air and moisture without which this chemical action cannot take place in any given climate or temperature, vegetation goes on rapidly, and all the plants which are suited to the climate grow in the greatest perfection, and bear abundant fruits.

It is not, however, very frequently the case that a soil possesses all those qualities on which great fertility depends. So many circumstances must concur to make a soil highly fertile, that the great majority of soils can only be made to produce abundantly by being improved by art both in their texture and composition. Hence the practice and science of agriculture, which is founded on experience, but to which every progress in science also affords great assistance, by the additional light which every new discovery throws on the true theory of vegetation.

There are various modes of distinguishing soils, without entering into a minute analysis of their component parts. The simplest and most natural is to compare their *texture,* the size and form of the visible particles of which they are composed, and to trace the probable source of their original formation from the minerals which are found around or below them, or the rocks from which they may have been slowly separated by the action of the elements. The science of geology, which teaches the relative position and nature of the minerals of which the outer crust of the earth is formed, is consequently of the greatest utility in aiding us to compare different soils and in ascertaining their composition.

The knowledge which geology imparts is however not sufficient for the minuter classification of soils; for it is found by experience that the soils which lie over or near the different strata, as they appear near the surface, vary greatly although they retain some general character which distinguishes them from others. The streams which descend from the hills, and flow towards the valleys, and through them to the sea, carry to a great distance the minuter portions of the minerals which they flow over in their course, while the larger and heavier are deposited much sooner. Hence the heterogeneous mixture of various earths and stones, and their stratification in thin layers, as is often found when a soil is examined which has never been disturbed by cultivation.

It is not sufficient to class soils according to the substance which predominates, as has been usually done, such as sandy, gravelly, chalky, or clay soils; for this gives very imperfect information respecting their nature or fertility; neither is it altogether sufficient to class them according to any particular geological formation.

The soils which have been evidently formed from the rocks, which are supposed to be of secondary formation, are fertile according to the proportion of the earths of these rocks which they contain.

Argillaceous earth exists in some proportion in almost every rock. It has the property, when mixed with other substances, as silica or lime, of fusing into a stone of great hardness and insolubility. In this state its effect on the soil is not to be distinguished from that of silica; and by burning common clay or clay mixed with carbonate of lime, a sandy substance is produced resembling burnt brick, which tends greatly to improve the texture of those clays which contain little or no sand in their composition. It must be remembered that the stiffest clays contain a large portion of silica in an impalpable state; but this, instead of correcting their impermeable and plastic nature, rather adds to it. It is only palpable sand which

with clay forms what is commonly called loam, and which, when the sand is in due proportion with a mixture of organic matter, forms the richest and most easily cultivated soils. Some of the rocks of secondary formations contain a considerable portion of alumina and lime; and when these earths meet with crystallised sand, a compound, or rather a mixture is formed, which has all the requisite qualities as to texture, to produce the most fertile loams. The only deficiency is that of organic matter; but this is so readily accumulated wherever vegetation is established, or can be so easily added artificially, that these loams may always be looked upon as the most favourable soils for the usual agricultural operations; and if a considerable depth of loam is found, which neither retains water too long nor allows it to percolate too rapidly, it may be looked upon as a soil eminently capable of the highest degree of cultivation, and on which no judicious outlay of labour will ever cause loss or disappointment to the cultivator.

* * *

The alluvial soils formed by the deposit of a variety of earths in a state of great division, and mixed with a considerable portion of organic matter, form by far the most productive lands. They will bear crop after crop with little or no addition of manure, and with a very slight cultivation. These soils are found along the course of rivers which traverse extensive plains, and which have such a current as to keep very fine earth suspended by a gentle but constant agitation, but not sufficiently rapid to carry along with it coarse gravel or sand. Wherever there is an obstruction to the current and an eddy is formed, there the soil is deposited in the form of mud, and gradually accumulating, forms those alluvial soils which are so remarkable for their fertility when carefully protected from the inroads of the waters. In these soils the impalpable matter greatly predominates; but the intimate mixture of the earths with organic matter prevents their consolidating into a stiff clay; and the gases which are continually evolved from the organic matter keep the pores open, and give scope to the growth as well as the nourishment of the roots. It is in the alluvial soils principally that an accurate analysis is useful; because the proportion of their constituent parts varies in innumerable degrees. It may be laid down as a general rule that the most fertile of these soils are those in which the earths are nearly in equal proportions, silica, however, being the most abundant, with about 10 per cent. of organic matter.

* * *

Organic matter is no doubt essential to great fertility in a soil, but some soils require more of it than others. In every stage of its spontaneous decomposition it keeps the pores of the soil open, and admits, if it does not even attract, air and moisture to the fibres of the roots. In all rich soils which have been long cultivated, especially in gardens, there are particles of a dark colour and fibrous texture, which in the microscope appear like minute logs of charred wood. These keep the soil open, and supply carbonic acid, when the air reaches them. A proper texture seems an indispensable condition of fertility. It is much easier to supply the deficiency of vegetable matter in a soil, which at best forms but a very small portion of it, than of silica or clay, which should enter into its composition in the proportion of one-half or a third of the whole. It is practicable to carry lime or chalk upon soils, which do not contain calcareous matter; clay may also be carried upon loose sandy soils, where it can be found below the surface, or at a moderate distance; but if a soil is very deficient in silica, it requires so large a proportion of this earth to give porosity to stiff clay, that it very seldom can repay the trouble and expense. Hence the difficulty of bringing poor wet clay soils into a fertile state, except where an abundance of chalk and vegetable manures can be easily procured. In this case the perfect draining of the land, and exposure of the ploughed

surface to the cold of winter, with the addition of chalk and manure, produce such an alteration in the texture of the clay, that by continuing the improving process it is entirely changed into a mellow and fertile loam. The burning of a portion of the retentive subsoil into a brick-like earth gives it a porosity which renders it mechanically similar to silicious sand, and converting the iron which all these clays contain into a peroxide, the soil is thereby greatly improved in fertility; for it seems that iron, in a state of slight oxidation, or combined with any acid, is hurtful to vegetation, whereas the red peroxide is not only innocuous, but seems to have fertilising properties.

In ascertaining the value of a soil for the purposes of cultivation, two circumstances should be carefully noticed. The first is the permeability of the soil to water: and the second is its power of absorbing moisture from the atmosphere. To ascertain the first, it is only required to place an equal weight of different soils in glass tubes of equal diameter, pressing them so that they shall occupy equal spaces, but not filling the tubes. Then pour an equal quantity of water over each soil, and place them upright with cups under them. Examine which has the surface first dry, and how much water runs through each in a given time. That which presents a dry surface, while it holds most water in its pores, is probably the best. To ascertain the comparative absorption of moisture, the soils are dried in pairs on a plate of metal heated by steam, or at a heat of 212°, to expel the water. They are then placed in equal quantities in similar flat cups or dishes, and placed in opposite scales of a balance, and poised. The apparatus is exposed to a moist atmosphere out of doors, or in a cellar, and occasionally examined. That which is heaviest is, in general, the most fertile.

It is often useful to ascertain roughly the composition of a soil, without having time or opportunity to make accurate experiments. A graduated glass tube, which can be carried in the pocket, and a small phial with a ground stopper, containing diluted muriatic acid, and secured in a wooden case for fear of accident, is all the apparatus required. A little of the soil is taken and moistened with water, a few drops of the acid are poured on; and by the greater or less disengagement of bubbles the proportion of calcareous matter is guessed at, and its presence proved. The soil mixed with water is poured into the glass tube and well shaken. In a few minutes the coarse sand is deposited shortly after the finer sand, and, lastly, the clay and impalpable matter, of which the lightest remains longest suspended. Distinct rings can be observed in the deposits, and the graduated tube shows their proportion. A person accustomed to this method will guess with great precision the general qualities of the soil; and when the geological structure of the neighbourhood and the nature of the subsoil are taken into consideration, the value of the land for cultivation is guessed with little danger of making very glaring mistakes. To surveyors and valuers this method is of a very great help, when other means are not at hand. Among the properties of soils of the greatest agricultural importance must be named the absorptive powers which they possess over ammoniacal and other valuable ingredients of manures, either volatile or soluble, which would otherwise be wasted when applied to the land. This fact, has been investigated and explains the economy of autumnal manurings and top-dressings in the winter season, when vegetation is inactive and unable at once to turn to account artificial stores of food for plants.

In practice, soils are usually divided into light, mellow, and stiff; but this gives very little information, there being every imaginable variety in each of these. There are still minute circumstances which produce great fertility or the reverse, and which it is difficult to investigate. An accurate chemical analysis, which, however, is a process requiring the service of the educated chemist, joined to a carefu

mechanical examination, and very correct accounts of the average produce under different systems of cultivation, can alone give us a scale according to which the natural fertility of different soils can be classed; and this must be the work of time and industry joined to science and practical knowledge. Directed as it is to the detection and estimation of ingredients, many of which occur in very small proportion, the process of chemical analysis is one which cannot be undertaken by the planter. It is sometimes useful to him, however, to know the exact composition of his soil, and the chemist is thus sometimes able to point out the causes of infertility, and so enable him to remove them. When, therefore, he is at a loss, such an analysis may be the guide he needs; and in a deficiency of phosphate of lime, or an excess of chloride of sodium, or a deficiency of organic matter, or in the presence of iron salt which is thus detected, he may read the cause of his failure, and so be able to remove it.—*English Cyclopædia.*

Loam.

Loam, a soil compounded of various earths, of which the chief are silicious sand, clay, and carbonate of lime, or chalk. The other substances which are found in loams, such as iron, magnesia, and various salts, are seldom in such proportions as materially to alter their nature. Decayed vegetable and animal matter, in the form of humus, is found in loams in considerable quantities, and the soil is fertile in proportion.

According as the loams are composed, so they vary in quality. Those which consist of a great portion of loose sand, with little vegetable matter, and with an impregnation of iron, are very unproductive; and those which contain too much clay, and are on an impervious subsoil, are very difficult to cultivate. But between these extremes there are soils which cannot be surpassed in fertility. What renders loams so much more fertile than either clays or sands, is that the pure earths are in themselves almost entirely barren: sand lets the moisture run through it and evaporate rapidly; clay retains it, but locks it up in its own substance, and does not allow the tender young roots of plants to push through it; chalk has the same mechanical quality, besides containing very little organic and soluble matter, from which plants derive their chief increase. Sand and clay alone without a considerable portion of organic matter will not make a rich soil; but when a portion of calcareous earth is joined to both, the vegetable matter is more readily rendered soluble, and the clay and sand are prevented from forming a mortar, which would harden too readily, and prevent the influence of the air from reaching the roots. Good loams allow of that circulation of moisture which acts so prominent a part in the process of vegetation. It is almost universally admitted that the most fertile soils always contain a proportion of calcareous matter; and by adding chalk to those soils in which it does not abound, whether sandy or argillaceous, a manifest improvement is always produced.

The greater the natural moisture of any climate, the greater proportion of sand is required to make a fertile loam; and the greater the proportion of humus, the less sand will be required to temper the clay. The analysis of soils known to be extremely fertile gives a very great difference in the proportions of the different earths.

The soil which is generally preferred for cultivation is a loam, rather light than heavy; at least half of which is silicious sand, one-third clay, and the rest chalk. Such a soil is called a good loam; it is land which will produce almost everything which is usually cultivated on sands or clays. It is of most easy cultivation at all times of the year, provided the subsoil be sound, and not too retentive of water. It requires only to be occasionally recruited with manure, to restore to it what vegetation has consumed, and to be kept free from the weeds which naturally spring up in all fertile soils. All attempts to improve the nature of a soil should have for their object the bringing it to a state of loam, by the addition of those substances which are deficient. If there is too much clay, chalk and sand may be added, or a portion of the clay may be calcined by burning, in order to destroy its attraction for water, and thus act the part of sand in forming the loam. Limestone or calcareous sand and gravel are still more efficacious for this purpose: they not only correct too great porosity or too great tenacity, but also act chemically on the organic matter in the soil, rendering it soluble, and fit to be taken up by the roots of plants. If there is too much sand, marl composed of clay and chalk is the remedy. Good loams require much less tillage than stiffer soils, and will bear more stirring to clean them than sands. Hence they are cultivated more economically, and more easily kept free from useless weeds. If there should be means of irrigation, no soil is better suited than a light loam on a bed of gravel; or even if the subsoil is clay, provided sufficient under-draining prevent the water from stagnating between the soil and subsoil, which, as practical men

very properly express it, would poison any land.

A loamy soil requires less manure to keep it in heart than either clay or sand; for while it is favourable to the process by which organic matter buried deep in the soil is converted into insoluble humus, it also permits that part of it which is nearer to the surface to attract oxygen from the air, and thus it is converted into a soluble extract, which is to the roots of plants what the milk of animals is to their young—a ready-prepared food easily converted into vegetable juices.

The analysis and classification of soils is of the greatest importance to all those who take up Grants; for the lease of land is sometimes not proportioned to its intrinsic value: one Grant may be worth double another, where the apparent difference in the soil is very trifling. Those who have had long experience of the expense of cultivation, and the average produce of certain lands, can nearly guess what land it may be safe to take up; but a stranger has no criterion to judge by. Why should not the value of a soil be ascertained as readily as that of any article of commerce? If there were certain points of comparison, it would be so; but in this the theory of agriculture is woefully deficient. A man guesses at the qualities of land by the colour, the feeling, and other uncertain signs: it seldom or never occurs to a planter to examine the component parts of a soil, by merely diffusing a portion in water, and testing the deposits—much less to compound artificial soils, and compare them with those found on his garden. Yet every gardener can prepare soils suited to different plants, and make loams of all degrees of richness or consistence. In all these it will be found that sand, clay, chalk, and decayed vegetable substances, in various proportions, are the chief ingredients. If therefore these are found in a natural loam, we may safely conclude that it would be equally productive, and the deficiency of one ingredient may be supplied artificially. This would be going rationally and scientifically to work; and the result would be a more certain and satisfactory practice of husbandry.—*English Cyclopædia.*

MARL.

MARL, an earthy substance found at various depths under the soil, and extensively used for the improvement of land. It consists of calcareous and argillaceous earth, in various proportions, and as the former or the latter prevails, so it is beneficially employed on clays or sands. There are several distinct sorts of marl—clay marl, shell marl, slate marl, and stone marl. The clay marl has probably been formed by the slow deposition of clay suspended in water, and mixed with the particles of decomposed shells. When these shells have retained their form, or appear in fragments in the marl, it is called shell marl. A considerable compression and a complete decomposition of the shells form slate marl and stone marl. The effect of marl is the same as that of clay and chalk upon sandy soils; on heavy soils its effect is proportioned to the quantity of calcareous earth which it contains. The peculiar advantage of marl is its readily crumbling to powder by the effect of air and moisture. If it is too compact to dissolve under these influences, it can only be made useful by burning, and in this case it is only a substitute for lime, its value depending on the proportion of calcareous earth in the marl.

Marl is often found very near the surface, so as to mix with the soil in ploughing; but unless there be a sufficient depth of soil above, its presence does not indicate great fertility. It is generally best when found at a moderate depth, so as to be readily dug out and conveyed on the adjacent lands.

Where a marl containing a large proportion of clay is found in many places under a light soil, it is frequently spread over the surface at the rate of two or three hundred cart-loads per acre. This dressing, joined to underdraining, makes a wonderful improvement on soils which before were scarcely worth cultivating, owing to their being loose and wet in winter. The clay marl makes them retain sufficient moisture, while the superfluous water is carried off by the drains.

Marl when put fresh upon the land requires some time in order to become effective. It should therefore be laid on the surface and spread before winter, leaving it there for a considerable time before it is ploughed in. It is most advantageous to put it on the land when it is in grass, and to roll and harrow it repeatedly, in order to expose it to the effect of the air and rains.

An excellent use of marl is in forming composts with dung and peat earth. It is laid in layers with the dung and peat, and if the heap is well soaked with urine or the washings of stable-yards, it will in a short time become a most valuable manure for all kinds of soils. Many peat bogs are formed on a marly bottom; where this is the case, and it can be drained, or the water got rid of in any way, the marl, when laid on the surface, consolidates the peat by its pressure, and soon makes it capable of producing good herbage by converting it into a rich vegetable mould.

The expense of marling land can only be calculated when the distance of the marl and the depth from which it is raised are known; when it lies in a stratum under the land, it is generally the cheapest plan to open a pit in each field; for the carriage of the marl is the chief expense. Within a distance of two hundred yards from the pit, it is found by experience that the cheapest way of putting

it on the land is by means of men wheeling it in barrows with the help of planks, as is done in digging canals and other similar public works.

It is in the compound character of certain limes that the subject of marling becomes connected with that of liming. As extraneous matters increase in quantity, and the lime diminishes, the effect of the application of course depends less and less on those considerations which explain the effect of liming, and the influence of the application of marl depends more and more upon the clay or sand, or it may be other things in smaller quantity which are thus conveyed to the land.

In a great many, perhaps the majority of instances, marl owes its fertilising influences to the lime which it contains, and then its effects are precisely those which lime would produce—sweetening herbage, increasing the quantity and improving the quality of crops. This it cannot do so energetically as is done by caustic lime, what lime it contains being in a state of carbonate: its dilution however, by other earthy matters, gives it almost as great facility of mixture with the soil as is possessed by caustic lime on its reduction to powder by slaking.

In so far, however, as marling acts by its calcareous ingredient, its use has been supplanted by that of burnt limestone.—*English Cyclopædia.*

TEA SOILS:

THEIR SELECTION AND IMPROVEMENT.

(1).—Mechanical Improvements of Tea Soils.

THERE is, we can assert with confidence, no subject of so intense an interest to the tea planter, nor one which so deeply affects his prospects, or on which so much depends the success of all his labour, as the *soil* of his garden. It is through the soil alone that the planter can assert any influence upon the tea plants; the soil is the only medium through which he can reach it, atmospheric and climatic influences being beyond his reach.

Intending to give our readers a course of articles on the culture of tea, we propose to open the subject with a discourse on *the selection of tea soils* in the first place, intended for those who desire to open out new plantations, or extend established ones; and in the second, the improvement of badly selected soils, so far as they are possible or feasible in already established tea gardens. These improvements, again, we shall have to consider under two heads:—the one comprising those which can be effected by *mechanical* means, the other those which can only be attained by *chemical* agencies. We will open our discourse by assuming that a certain district for a new tea plantation has been decided upon. The intending tea planter will now, of course, look out for the site most suitable for his purpose. We do not intend to enter now upon the general principles by which he should be guided,—such as proximity of running water, abundant labour, abundance of manure, facility of transport, etc.; all of which form important items by which his selection must be governed if he would wish his garden to be a paying one; but leaving these subjects for future consideration, we proceed to shortly point out *the physical and chemical properties essential to a good tea soil.*

In the first place a steep slope should be avoided, by reason of the facility with which the uppermost layer of the soil, that is to say the most fertile one, is washed away by the heavy rains as soon as the protecting forest and brushwood have been cleared off.

A site at the bottom of a hill with a gentle slope may be considered the most favourite position a garden can occupy, and the intending planter will be guided accordingly.

In order to select and judge different soils we must regard in the first instance the requirements of the tea plant, both *physical* and *chemical.* Now it has been found that mature tea trees in most favorable situations spread their roots far below into the subsoil to a depth of six and even seven feet; the rootlets are very tender and delicate, and as their extension and the force with which they have to work their way into the lower

layers may well be compared with the force with which a nail is driven into a plank, an essential feature of a good tea soil will be porosity and friability down to a depth of at least five feet.

If a heavy and impermeable clay stratum intervenes above that depth, the rootlets of the tea plant will be unable to overcome the resistance offered, and will spread horizontally: the plant will become more or less a surface feeder, and will be easily affected by droughts or extreme cold. If such a soil is situated on a level the evil will be increased by the presence of stagnant water—an invariable result of a clayey stratum in the subsoil; and it is well known to planters that nothing injures the tea plant so much as stagnant water around its rootlets.

The most desirable qualities a good tea soil should possess are therefore that it should be loose and friable to a certain depth, and be on a gentle slope.

A soil which, when wetted, crumbles away between the fingers, will generally be found sufficiently friable and porous for the requirements of the tea plant.

Regarding the *chemical* constitution of a tea soil, many opinions of most contradictory character have been expressed. It has been stated that tea will grow on almost any soil; and the fact has been made use of, that in China only such soils are selected for tea as are unfit for other crops. But it has been omitted to mention that the Chinese restrict their cultivation rigidly to the amount of manure available; their principle is—"without continuous manuring there can be no continuous harvest."

We have yet to meet the tea planter who, in deciding how many acres he will cultivate, is guided by the amount of manure available. Abundance of it is, no doubt, valued by him, but a want of it will not influence him to reduce the acreage of his garden.

But though the different opinions expressed by many good judges of tea soils may appear most conflicting to the superficial observer, they can nevertheless be reconciled upon a broad basis which cannot be disregarded by the intending tea planter.

Some of the *best tea soils* we have found to agree in the following particulars:—A layer of a porous loam, six to twelve inches deep, containing not less than 50 per cent. of sand, about 4 per cent. of lime, and 5 per cent. of organic matter, the remainder being clay, of a light colour when dry, yellow or reddish yellow in the lower layers, with a porous sandy or ferruginous sandy subsoil extending to not less than 5 feet, with about 10 to 20 per cent. of clay, and free from too great an admixture of stones or boulders.

These particulars will suffice in guiding the planter in the general selection of a soil for his tea garden; and the closer he can come to it, the surer will be his success.

The question now naturally suggests itself, how can planters who have selected bad soils and bad sites, and who have expended considerable amounts of money in their cultivation, retrace their steps? We will take two instances, connected with the *physical* character of soils, into consideration. First, we shall have regard to gardens which have been established on steep slopes, on the sides of hills. The common complaint of their managers is the gradual impoverishment of the soil occasioned by each rainy season. The force of the water washing over the lands, removes, year after year, a portion of the uppermost, *i.e.*, the most fertile layer of the soil, and the wash resulting from the resistance of the tea plant is sometimes so great that the roots are laid bare. Such a tea garden is placed at a great disadvantage, for the higher the soil is cultivated the greater the loss. Much digging during the rainy season is out of the question: weeds consequently spring up in abundance, and any manure which may happen to be applied is sure to be washed down to benefit the nullah or river.

The remedy which appears to us to meet this case is the construction of a network of drains, 2 to 3 feet deep, firmly embanked on both sides to a height of 12 or 18 inches.

We would make each area enclosed in the first instance not less than 100 yards square; but in any case the drainage should be sufficient to draw off all rain water *through* the soil, and prevent it from washing *over* it. The expense thus incurred will, in our opinion, be fully compensated by the lasting benefits accruing: first by staying the further impoverishment of the land, and secondly by permitting a high cultivation of the soil.

From site we will pass to soil, and take into consideration tea gardens, where a not less serious error has been committed in the selection of the soil. We refer to those which have been established on heavy clay soils, either so throughout, or porous in the upper layers, say for a couple of feet or so, but containing in the lower layers strata of impermeable clay which not only obstruct the passage of the tender rootlets of the tea plant and force it to become a surface feeder, but result also in insufficiently sloped sites, in the formation of stagnant water, so fatal to the plant.

Sub-soil drainage is the means open to the planter to improve such gardens. We would have drains not more than 20 yards apart on level or only slightly sloping lands, and not less than six feet deep on steeper slopes.

This distance may be increased, and as materials, such as tiles, pipes, &c., would be out of reach of the majority of planters, we would form the drain by stones, loosely put on a basis formed of twigs and boughs, and then level up with the dug-up soil.

The results which can be expected from thus sub-draining a heavy clay soil will be better understood when we bear in mind, that in most clay soils the portion within two feet of the surface is almost always more retentive than that which lies below; simply, we apprehend, because its particles have been comminuted and packed close by the alternative influence of wet and dry, heat and cold. When dried below by drains and above by evaporation, it is certain to crack and become permeable and friable by the access of the atmospheric air, thus allowing in course of time the most tender rootlets of the plant to pass through.

(II.)—*Chemical Improvements of Tea Soils.*

We proceed now to consider the *chemical* requirements of what should be a good tea soil, and by what means imperfect soils may be brought near the standard of perfection.

It is well known that the soil is the source from which the plant draws through the medium of the root the mineral or inorganic portion of its plant-food, the organic portion being derived through the leaves from the atmospheric air.

In order to determine now what mineral plant-food a would-be good tea soil must contain, and in what proportion, we must base our remarks upon the tea plant itself, and upon the inorganic substances we find in it as revealed by an analysis of its ashes.

Mr. Schrottky gives the composition of the ashes of young leaves of the *Assam hybrid* tea plant as follows:—

In 100 *parts.*

Chloride of Sodium	2·247
Soda	8·941
Potash	36·514
Magnesia	10·089
Lime	8·517
Oxide of Iron and Manganese ...	3·966
Phosphoric Acid ...	16·214
Sulphuric Acid ...	13·017
Silica	0·439
	99·944

And states that old leaves and stems will contain more lime and silica than here represented.

Now a soil, to be a *first class tea soil*, should contain all these constituents in proportions which closely approach the above percentage; that is to say, the rootlets of the tea plant should find distributed in the soil, for every 36 parts of potash 10 parts

of magnesia, 8 parts of lime, 16 parts of phosphoric acid, etc., etc. If we find, therefore, that any soil contains these substances approximately in the above proportions, not leaving out of sight that potash can take the place of soda, and lime that of magnesia, then indeed it would be impossible to further improve its *chemical* constitution. But it must be remembered that the mineral plant-food in the soil exists in two different states, which stand in very different relations to the requirements of the plants we refer to,—mineral plant-food in *physical* and in *chemical* combination. In the former state it is immediately available for the purposes of the plant, while in the latter it can only become so after the prolonged action of climatic and atmospheric influences upon it. At present we have only to do with the former.

Let us assume now, that we find in a soil all the different constituents of available mineral plant-food to be present in proximate proportions to those required by the plant, with the exception of phosphoric acid, of which, say, only 6 parts are available for every 36 parts of potash, etc.; then every pound of phosphoric acid added would render a corresponding quantity of the remainder of mineral plant-food, heretofore useless to the plant, available to it, and consequently stimulate the formation of new tissues; *i.e.*, increase the outturn.

We can distribute through the soil 10 parts of phosphoric acid in addition to the 6 parts already present, and we will thus make up the 16 parts necessary to correspond with the remainder of available inorganic plant-food. Every pound of phosphoric acid added in excess of this quantity is perfectly useless, as there is not the corresponding quantity of potash, lime, &c., present, and if we wanted to further increase the capabilities of the soil we would have to add the whole of the mineral plant-food in the proportion indicated in Mr. Schrottky's analysis.

What has been said of phosphoric acid holds, of course, good for any of the other substances: they have all certain functions assigned to them; they are all jointly and separately indispensable to the plant; and there is not one more important than any other, as far as the requirements of the plant are concerned.

If we should find that there is plenty of available phosphoric acid and lime, &c., but that for every 16 parts of phosphoric acid there are only 15 parts of potash present, we must add 21 parts of it in order to bring the proportion of available plant-food up to the standard required by the plant, and *thus enable the soil to produce its maximum* with a minimum outlay.

In fact it is that ingredient of available mineral plant-food which, if present in smaller proportion than required by the standard when compared with the rest, regulates the outturn of a tea garden; every additional pound of this substance added will start, so to speak, into life the slumbering power of the soil; every pound added will have a marked effect upon the outturn, until the quantity added shall make up the proportion in which it is wanted by the plant.

It is not always necessary to add the exact mineral wanted, if, for instance, we find a deficiency of available potash and phosphoric acid in a soil in which there is an abundance of these two substances in chemical combination as insoluble. Phosphate of lime and silicate of potash, an addition of common salt and burnt lime, will have the same effect as the addition of potash and phosphoric acid. For common salt will dissolve the phosphate of lime, and enable it to enter into physical combination with the soil, while the caustic lime will decompose the silicate of potash, and set the alkali free to enter into such combinations as are available to the plant.

It is, therefore, a most important point for the tea planter to ascer-

tain whether the available mineral plant-food present in his soil comes up to the standard required by the plant; or if not, what constituent is present in relatively minimum quantities. The determination of this point cannot be over-estimated in its importance; it may save the planter hundreds and thousands of rupees, and it is the only way by which he may know thoroughly the nature of the capital he is working with.

The knowledge of what available plant-food there is in the soil, and in what proportion, should be the basis of all agricultural operations: it should decide what manure is to be applied, and in what manner. It falls, of course, within the province of the agricultural chemist to supply the planter with the facts dilated upon, and it is our opinion that any expense thus incurred will be amply repaid by a judicious use of the knowledge acquired.

The first use of this knowledge should be to supply to the soil the minimum constituent of available plant-food, or if chemical analysis should reveal that abundance of this minimum exists in chemical combination, to add to the soil such substances as will free it from its locked-up state, and render it available for the purposes of the plant.

When the plant-food in the soil has by either of these means been brought up to the standard, all further manuring must have reference to what is withdrawn from the soil, and we cannot too much recommend the planter to bear in mind the Chinese axiom of agriculture that "*without continuous manuring there can be no continuous harvest.*"

SOIL.

A GOOD tea soil should combine the three qualities of light, friable, and rich; enough sand should be in it to prevent its "cakeing" or "balling," and yet not enough to prevent adhesion of its component parts when wetted. When sand is in excess, the plants, though they grow quickly at first, do not last well, and are not prolific; when, on the contrary, the soil is too clayey, the tea bushes, particularly when young, do not thrive, and their growth at all times is much retarded. From the fact that the Chinese only grow tea on lands unfit for other cultivation, the idea long prevailed in India that poor soils were best adapted to the tea plant. There never was a greater mistake. The Chinese do so, because, with few exceptions, tea *gardens* do not there exist as in India. In that country, each and every small farmer cultivates a few tea plants, which his family look after, and the price he obtains for the produce is so small that it will not pay him to carry it out on good land.

So the Chinaman plants his tea where he cannot plant other things,—often in hedges between his fields,—and naturally chooses his worst land. We see pictures, in books, of Chinamen picking tea-bushes on rocky crags, where how anything can grow at all is marvellous, and, more wonderful still, how the men depicted can cling to the stony precipice. Sometimes the effect is heightened by finding that, in truth, the Chinese, not being flies, cannot hold on in such places, and are, therefore, supported from the summit in huge baskets with iron chains! We are told, moreover, that in such localities are produced the finest teas China boasts; that they, and they alone, are served at the Royal table, &c., &c. This is all nonsense. Why tea in the flowery land is grown on poor ground (we much doubt, strong as the tea plant is, its growing on rocks) we have shown; but a rich and a good soil is necessary to make it produce largely and pay well.

Let any one dig into virgin ground, particularly forest land, and he will find a super-stratum, some five to eight inches deep, of dark-looking mould. This is the decayed vegetable deposit of centuries, never yet turned up, and its presence to a greater or less extent determines, together with the chemical combination of the earth, what degree of richness it contains. There is no manure for the tea plant so efficacious for quick and lusty growth as this said vegetable deposit. It varies much in quantity or thickness on different lands; nine inches, or thereabouts, being the maximum, two inches the minimum. It exists nowhere in such perfection as on the Himalayan ranges. In the dense forests of those districts, which we may conclude have stood as they are for many ages, the leaves have yearly decayed as they fell, and have enriched the ground

to a wonderful extent. We have seen it—we mean this vegetable deposit—nine inches to a foot in thickness in some of the high elevated oak and rhododendron jungles. The leaves of both these trees, when they decay, leave a richer deposit behind than any others in the Himalayas or Bengal. We would not ourselves select, for a tea garden, soil which showed but little traces of this vegetable deposit, for we hold that the plants would lack nourishment from the first; and, therefore, though we would not, for climatical reasons go to the Himalayas, where it is most abundant, we should certainly regard its existence as a *sine qua non* in any site we chose in Eastern Bengal. Under this varying depth of vegetable manure, which is, of course, at top of all, is found the surface soil, averaging about nine inches in thickness. This it is which must be, as we said before, "light, friable, and rich." Later, when the land is cultivated, this, and the vegetable deposit in the surface, are mixed together, and make, if the latter is abundant, and the former of good quality, a rich mould highly suited for tea plants. Below this we have the sub-soil, on the perfection of which much of successful tea cultivation depends. The tea plant has a long tap-root, which in all cases penetrates below the two surfaces described; and, if the moisture and nourishment which it seeks in so doing is not to be found in the sub-soil, the site is far from perfect for tea cultivation. The richer and the moister the upper stratums, the less deep does the tap-root go. Still, it must always go down some way, for, if even nourishment enough exists in the upper layers, in times of drought, moisture cannot; and thus the quality of the sub-soil is all important.

Iron is, we hold, necessary for tea; that is to say, the presence of iron in the ground. If the sub-soil has a ferruginous nature, it may be decided at once by its colour, which, in that case, is more or less red. It may, however, be too red. Besides the presence of iron, it is necessary to see that it is porous, and yet will retain moisture. We cannot, however, enter here into a treatise on tea soils; the few hints we have let drop will enable intending planters to judge somewhat for themselves. But, more important still,—we wish to show which district, as regards *soil*, is the best tea district.

Eastern Bengal undoubtedly possesses the finest tea climate, but the perfection of soil exists in the Himalayas. There is nothing, we believe, in Assam, Cachar, or Chittagong (though there are a few tracts in the latter district very rich) to equal in strength the virgin oak and rhododendron forest-land of the Himalayan ranges. Nowhere have we seen the same depth of vegetable deposit as exists there; and we believe it is this quality, and this alone, that has enabled the hill gardens to struggle on so long as they have done. If any fault for tea growth exists in the Himalayan ground (we, of course, speak generally) it is that in some places it is too stony, and in others that the sub-soil is too tenacious. But these disadvantages are more than counterbalanced by its richness; and could we transport Himalayan earth to Eastern Bengal, we should have nearly perfection both as to soil and climate.—[*Tea Cultivation in India.*]

CLIMATE.

TEA, it may be premised, will grow almost anywhere, but not very many climates will enable it to pay.

To describe the best climate in two words, we point confidently to Eastern Bengal; indeed, the judgment of a considerable portion of the Indian public interested in tea has long since pronounced the same decision. A hot, moist climate, where the thermometer in the shade never exceeds 95°, never falls below 55°; where the rainfall yearly aggregates 100 to 130 inches; where there is never any long drought, but where rain falls at reasonable intervals all the year round; where heavy dews are frequent; where morning fogs are not uncommon; where the sun shines hot in an atmosphere perfectly free from dust; where at no season can a breath of hot wind be felt; where light, penetrating rain is more common than furious downpours; where the effect of the entire climate is essentially enervating to man, and takes much out of him;—these are the conditions that constitute, in our opinion, good climate for tea, and where it is wise, if wise anywhere, to make tea gardens. Fever and tea go together. It may be a painful fact for tea planters, but it is no less true. No highly successful tea district can ever be a healthy one.

Begging the question that we have truly defined—the climate necessary for tea—it must be evident, to those who know India well, that Eastern Bengal, alone pos-

sesses all the conditions. All Eastern Bengal is not equally good; but of this later. Let us shortly review the climate of other tea districts, and see where they are deficient. It is not a pleasant task. Many have, or are interested in, gardens out of our elected magic circle. What, then,—the truth, the results will not be affected by the opinions we express; and free discussion on this, as on all other matters, can do no harm. If wrong, let those who know better correct us.

Darjeeling is too cold. There are gardens on the lower slopes which may yet answer well, but cold is doubtless the characteristic fault of that district. Already has the knowledge been acted upon, for more than one of the plantations at *high* elevations has been abandoned. That tea will grow and flourish, as far as size and strength goes, at almost the highest elevations, we know well, for we have seen plants at Nainee Tal, 6,700 feet above sea level, of an enormous size. They do not, however, flush often or abundantly. The objections to Darjeeling apply in a greater measure to Kumaon: the latitude is higher, and similar elevation produces more cold there. Again, however, in that province may sites be found—low valleys in the interior of the hills—where greater heat prevails; as, for instance, the Kuttyoor valley, but the winter mornings are bitterly cold all the same. The elevation of the Dhoon is not great—some 2,000 feet,—and so far is unobjectionable; but it partakes of the general character of the North-Western climate; the moist heat of Bengal is wanting. Again, the Kangra gardens, though not so elevated as many in the Himalayas, are at a high latitude, and would doubtless be better did more heat exist in the winter time, and were there less of the dryness characteristic of that part of India. Oude has very decided hot winds, which we cannot doubt are prejudicial; and the same objection, though in a far less degree, will apply to Hazareebagh.—[*Tea Cultivation in India.*]

Conditions of Soil and Climate most favorable to the Growth of the Tea Plant.

Soils.

Essential Ingredient.—Lime is an essential ingredient in all fertile soil. In 1,000lbs. of such soil there are 56lbs. of lime, while barren soils contain only 4lbs.—*Professor Johnstone.*

Division of Soils.—Soils have been divided in the following way according to the proportion of clay, sand, and lime which they possess:—

"1*st.*—Argillaceous soils, possessing little or no calcareous matter, and above 50 per cent. of clay.

"2*nd.*—Loamy soils, containing 20 to 50 per cent. of clay, with a little lime.

"3*rd.*—Sandy soils, containing not more than 10 per cent. of clay.

"4*th.*—Marly soils contain from 5 to 20 per cent. of calcareous matter.

"5*th.*—Calcareous soils contain more than 20 per cent. of carbonate of lime.

"6*th.*—Humus soils are those in which vegetable mould abounds."—*Professor Balfour.*

Why a Soil should be analysed.—The benefits to be derived from the chemical examination and analysis of a soil are by many misunderstood. Some have represented it as the only sure guide to successful cultivation, while others have not scrupled to pronounce the analysis of soils to be entirely useless, and unfitted to lead to any profitable practical result. Both of these extreme parties are in error. For while it is often very difficult, from an analysis alone, to explain either the past agricultural history, the present money value, or how best to remedy the known defects of a soil, yet there are many practical points on which analysis does throw light, and modes of practical treatment which it serves at once either to discourage or to recommend.—*Johnstone.*

Rich Soil.—A rich soil generally contains five per cent. or one-twentieth of its weight of organic matters, in combination with clay, sand, iron, lime, magnesia and certain other fertilizing substances.—*Pogson's Practical Agriculture.*

Tea Soils—Are remarkable for containing much iron and very little lime, with potash in larger, and soda in smaller, quantity. The presence of manganese is one of the peculiarities of these soils.

Differences of Soils—Are, to a very great extent, explained by the geological characteristic of the localities in which they exist. Any one who has observed the appearance of large rocky masses, the clefts and crevices they present, the bare surface of their smoother and harder parts, the growth of mosses and smaller plants on the more softened portions, the accumulations of gravel, smaller fragments of minerals, and fine mud, with their luxuriant vegetation at the foot of these rocks, and in the valleys of mountainous districts, must be aware of the importance of these ever-continuing operations in nature.

Kamroop.

Major W. J. Lance, Officiating Deputy Commissioner.—"Opinion appears to differ, as

is to be expected, in some respects as to the conditions under which tea best thrives; in some cases highlands, and in others lowlands, being preferred, tea is cultivated both on small hillocks (called teelas in Assam) and in the Terai plain of the district. Both are equally good in their way, though with reference to the first an additional question of aspect has to be considered, which is wanting in the case of low lands. As to what aspect is best, general experience seems to point in this district to north and easterly ones; it being maintained that the south and west being more exposed to the sun, the soil in this hot climate fails to retain its moisture sufficiently for the plant. It is evident, however, that the effects of aspect are liable to be influenced to a degree by the other points of soil, rainfall, and slope of hills. Teelas, &c., are further subject to a heavier rush of water than level lowlands—an inconvenience which has to be guarded against by terracing, &c., and which, if the slope be considerable, is certainly a drawback as regards teelas compared with lowlands. In both cases (teelas and lowlands) the usual conditions of heat and moisture are equally demanded by the plants; whilst as to soil, the rich dark soil, the produce of ages of decaying vegetation, seems to be that in which the plant thrives best, though very good tea is produced from parts where nothing but stiff clay is to be found. Forest land is usually preferred to that consisting of merely grass jungle, owing to the shade which may be obtained in the former case by leaving a proportion of the trees to protect the ground, and so make it retain its moisture. In cases where lowland is selected, it is essential that it admits of proper and easy drainage, as without this the land suffers from the retained moisture."

Durrung.

Major Graham, Deputy Commissioner.—"A red sandy sub-soil, covered with vegetable matter, is found to be best adapted for tea."

Captain M. O. Boyd, Assistant Commissioner, Mungledye Sub-Division.—"The lands most favorable for tea cultivation in this sub-division are the highlands in the neighbourhood of the frontier, and the small plateaus formed by the action of the rivers which run southward into the Brahmapootra."

Nowgong.

Mr. T. W. Greaves, Manager, Upper Assam Tea Company.—"Tea only does well here in close proximity to the hills. As a district, Nowgong may be said to be low, flat, and badly drained; whilst the soil is too black in color, and too stiff in consistency, to be well adapted for tea. But on approaching the hills these objections disappear, and both soil, drainage, and climate improve vastly—so much so, that I believe the land we have at the foot of the hills is not easily to be surpassed in Assam."

Seebsaugor.

Mr. S. E. Peal, Sapakati.—"As a knowledge of the requirements of the tea tree is becoming extended, it is gradually becoming apparent that while tea will actually grow or vegetate in almost any climate out of the Arctic, so it seems equally clear that an evergreen shrub, which is cropped so often and systematically of its foliage, needs a climate throughout the year, that is both hot and moist, and that contains, *par excellence*, the essentials for rapid and sustained growth; and that in direct proportion as the climate is subject to (even partial) droughts, or comes within the influence of hot or dry winds, in the same proportion it is directly unsuitable for the growth of tea as a 'national enterprise' which is to succeed by the weight and rapidity of its crops of young leaf.

"Many parts of India, Central, Southern, and North-West Provinces, present for a portion of the year the climatic conditions necessary, and which are best found in Assam and Cachar, and perhaps the Dajeeling Terai; but unlike these latter, the favorable period is so short, that there could hardly be said to be a 'tea season' at all.

"An investigation of the number of flushes or rapidity of growth would be a direct and certain mode of ascertaining the suitability or otherwise of a province for tea growing, and the tracts showing this will be found to be almost exclusively those whereon there is a steady monthly average rainfall with suitable warmth.

"In many parts of India the rainfall for the year is the same as in Assam, but it falls in a few months, and is preceded and followed by droughts; and it is needless to say that when a continuously hot and *moist* atmosphere is essential, that those places are unsuited. It is most noteworthy also that only in those places having a hot moist atmosphere for greater part of the year, is tea to be found indigenous."

Golaghat.

Captain Blathwayt, Assistant Commissioner.—"It seems very generally agreed that the climate of Upper Assam is as good for tea as can be found anywhere. Colonel Money says: 'The climate of the northern portions is perfect, and for climate I accord the first place to Northern Assam; and Mr. Watson, who obtained the second prize for his essay on Tea Cultivation, gives it as his opinion that Assam and Cachar are the only two climates suited for tea; and that this climate is excellent for the purpose, is the opinion of all planters I have consulted on the subject.'

"The general idea appears to be that a great variety of soils are suitable for the growth of tea, provided it is not too loose,

and on the other hand, that it is sufficiently porous to prevent water stagnating about the roots of the plants."

Mr. George Stocks, Manager, Brahmapootra Company.—"The soil best suited for tea in my opinion is slightly undulating, with falls of from 6 to 8 feet of a strong nature and moderately intermixed with sand. This is to be found on all old forest land, and the rich vegetable mould found in deposit on the surface, when cleared, is a very great help to the growth of the tea plant.

"I have not seen tea-planting in any other district in Assam, but feel confident that the climate of this province is well suited for tea."

JOREHAUT.

Mr. Carnegy, Assistant Commissioner.—"Tea is grown on many descriptions of soil, where the ground is high enough to be above inundation, but it undoubtedly thrives best on a light yellowish loam resting on a sandy sub-soil; the soil ought to be virgin, also either naturally or artificially drained. As to climate, the warmer and damper it is the better for tea. In this sub-division there is but little difference in any one part from the rest in climate, so that the different gardens are on a par in that respect. The best weather for tea is when heavy showers fall during the night, and the days are hot and close."

LUCKIMPORE.

Major W. C. Clarke, Deputy Commissioner.—"The conditions of soil and climate under which tea has been found to thrive most, are stated to be a loose rich loam, with a good mixture of sand, described by some as a friable loam, and by others a sandy loam, —a hot damp climate, with regular rainfall of say 90 to 100 inches, alternating with hot bright sunshine. The soil and climate which produce vast bamboo forests are also stated to be excellent for tea, and I am of opinion that such land is becoming more in demand."

CLOSE PLANTING *versus* WIDE PLANTING.

BY LOOSHAI.

IT was somewhere, in the *Tea Gazette* I think, that I saw a query anent *close* planting of tea, *i.e*, planting at distance of 3′ × 2′, 3′ × 3′ and 3′ × 4′, and closer. Whether it was better to plant thus or a wider distance apart, 4′ × 4′, etc. Well, to answer this query, I presume a good class of plant is to be planted, and I ought to take for granted that my querist knows the *benefit* which is to be derived from hoeing and picking (the latter with a pick and not a fork for *loosening* the soil) and the diameter across or through of an average sized bush of a good class—be it "Indigenous," "Hybrid," or "China," and *where* the new growth and produce of a leaf producing plant or shrub are to be looked for. In case I may be mistaken as to this amount of knowledge on the part of my querist, who perhaps is a mere novice or tyro in his dealings with the soil and its production, I may as well inform him that—

1. *Hoeing*" and "*picking*," not forking (with three and four pronged forks) round and about and amongst plants or bushes, consists in breaking up or reducing the soil into fragments, and allowing it to remain in that state exposed to the action of the weather. By this means the stony and rocky particles of which the soil is composed are made to crumble or break into small pieces by the influence of the gases, air, and moisture, and the alkalies in it to be set free in a proper state for the plants to take up. It is therefore evident that frequent hoeing and stirring up of the soil (not merely *loosening* it) must facilitate the decomposition of the mineral matter in the soil and serve to *improve* its productiveness, for a new source of carbonic acid is created in the soil (by hoeing, etc.) by decaying vegetable substances, and the *roots* at the same time absorb three times as much carbonic acid from the soil as the *leaves* derive from the atmosphere: thus the plants increase four-fold. This increase extends to the leaves, buds, and stalks; and in the increased extent of *surface*, the plants acquire an increased power of absorbing nourishment from the air. "Hoeing" and "picking" is also necessary to open up the soil to the influence of the sun and air, and moisture, to ærate the soil and *preserve it* from *sourness*, to make the soil more easily penetrable by the

roots of the plants than if left caked or hard, and to permit the free growth of the roots which are thus set free.

2. The diameter of an *average* size tea bush of a class as above, of seven years of age, I have measured, and found to be from 4′ 6″ to 5,′ and in *some cases* more through or across, and the roots of course had extended, in an equal, or in all probability in a *much greater* degree.

3. The young growth and produce of all or nearly all leaf-producing plants or shrubs is on the *top*.

Having said what I have in the above few lines, I will begin to treat with the subject of *close* versus *wide planting* in parallel columns, whereby the disadvantages of the one and the advantages of the other may be the more readily seen.

Close planting versus	*Wide planting.*
3′ × 2,′ 3′ × 3,′ 3′ × 4′.	4′ × 4′.
The disadvantages are as follows:—	The advantages are as follows:—
1. It is impossible, after a very short time, to hoe, etc., and thus derive its benefits.	1. It facilitates hoeing, etc.
2. The trees, bushes, or plants are stunted in growing space, and space for proper cultivation, and cannot form themselves into vigorous and well-developed bushes; but, on the other hand, present a cramped and stunted specimen of what a tea plant should be.	2. The trees, bushes, or plants must grow much larger and finer by getting plenty of light, circulation of air, and sunshine.
3. It is impossible for labourers or coolies to get along the rows of plants in a *closely* planted area without damaging branches or flushes with their hoes or other implements and baskets.	3. Labourers *can* at all times get along the rows of plants without damaging branches or flushes with their hoes, and other implements and baskets.
4. *Impossible* to obviate damaged branches, etc., by implements, etc., which are a fruitful source of attraction for *white ants* and other *vermin* or *insects*.	4. Obviation of damaged branches, etc., by implements, etc., which are a fruitful source of attraction for *white ants* and other *vermin* or *insects*.
5. The soil having an *excessive call* made upon it by the *larger number* of plants per acre, needs a certain amount of cultivation to *strengthen* it, but *cannot* get it in the same degree as the *widely planted* area.	5. The soil *not* having the same *excessive call* made upon it, does not need the amount of cultivation that a *closely planted* area needs; and when it does, it *can better* receive the cultivation to strengthen the soil than the *closer planted* area.
6. The plants, being *planted closer*, impoverish the soil sooner on account of the closely conglomerated mass of roots choking the ground and themselves sooner than if planted *wider apart*, and rendering manuring necessary sooner for the same reason.	6. The plants being planted *wider apart*, impoverish the soil to a *less* degree than when planted *closer*, and hence manuring can be *deferred* for a *longer* time.
7. *More* chances of harbouring damp and chilliness about the stems of the plants and soil, the *concealment* and *action* of a *nursery of weeds*, and undue mois-	7. *Less* chance of harbouring damp and chilliness about the stems of the plants and soil, the *concealment and action of a nursery of weeds* and undue moisture owing

ture owing to the plants being so *densely* planted and *not* admitting of circulation of air, sun, and light,—all of which are so actually and essentially necessary for active and vigorous growth.	to the plants being planted wider apart, letting in sun and light to a greater degree and a more thorough circulation of air, all of which are so actually and essentially necessary for active and vigorous growth.
8. *Greater* chance of plants being affected worse by mildew, fungi and blight, red spider and other wingless insects; as the plants being so dense, the insects can *walk* from bush to bush without flying, as in the case of the matured blight insects.	8. *Less* chances of being affected by mildew and fungi, as well as blight, red spider, and other wingless insects, as the plants being *further apart* are subject to *less* shade from one another, a freer, and thorough circulation of air, sun, and light; and in the case of wingless insects as red spider, etc., the insect is unable to get to the next.
9. *Difficulty*, if not *impossibility*, in mitigating or eradicating blight, etc., being *closely planted*, labour being unable to get in and among the plants to search for pests of this sort, the plantation being so dense, and for the same reason a certainty almost of damaging the plants (*vide* reason 4,) showing what is likely to occur by having damaged branches, etc)	9. *Easier* to mitigate *or eradicate* blight, etc., being widely planted, labour being able to get in and among the plants to search for pests of this sort without fear of damaging the plants (*vide* reason 4, showing what is likely to occur by having damaged branches, etc.)
10. The bushes take more out of the soil (impoverish it) by being *closely planted* than the roots of the plants planted *wider apart*.	10. The bushes take less out of the soil than the closely *conglomerated mass* of roots of the *thickly* or *closely* planted area.
11. In a *closely planted* area it is impossible to strengthen or improve the soil by *hoeing* and *picking* without damaging and destroying branches and trees and cutting roots.	11. In a *widely planted* area the soil can be strengthened and improved by hoeing and picking, and allowing sun and light, etc., a free circulation of air in and amongst the plants; and when hoeing and picking, there is not that fear of cutting roots as in a *closely planted* area *if* it could be done.
12. The plants being *closely* planted, would cover the ground well and quickly, and quicker returns are got from an area planted thus, but the plants are cramped and stunted for want of growing space hence their yield is limited after a time to a greater extent than if they had been planted *wider* apart, and in time every alternate plant or bush will have to be cut out to admit of *proper* cultivation with the "hoe" and "pick," etc. The idea adhered to by some, that	12. The plants, though *wider* planted, cover the ground equally as well after a time, owing to the greater space allotted to each plant to grow upon, as those planted *closer* and the bushes would prevent vigorous, well-grown and well *developed* bushes spoiling less supply for a time, but increasing, instead of decreasing, afterwards (without having to cut out bushes, which have not only taken a portion of the nourishment of the soil

the greater the number of plants or bushes on a certain area the greater the yield, and this continuously, is, I think, a mistake, for the very closeness prevents yielding, which requires space, sun, light, a free and thorough circulation of air through the plants, and thorough and good cultivation (not merely loosening the soil, but laying it open to the air.)

13. The area being *closely* planted, *cannot* be cultivated by *hoeing and picking* before or when subject to "blight" and "red spider," consequently the bushes *cannot* be *stimulated enough* to compel them to form or burst new buds, the germs from which the new shoots or flush is to spring, as quick as is necessary in order that they should outgrow,

which the other plants left ought to have received, but the plants left stand a good chance of injury to themselves and roots during the process of cutting out.) On account of the space (developing) allotted each plant, as I said before, the free admission of air and sun and light, all which are essentially necessary for the well being of the plant, and especially the tea plant, which is subjected to plucking (and that the tenderest of its leaves) for nine months, and *shortly* or in some cases, *immediately*, followed by pruning.

13. The area being *widely planted, can* be cultivated by *hoeing and picking* when subject to "blight and red spider," and the bushes respond to the call made on them by *cultivation*, for new buds and growth, sooner than when *uncultivated*, thereby *outgrowing*, so to speak, the insects (blight). When this is attained, the insects having *more* leaf to destroy or to feed

so to speak, the *blight*, which is of greater importance than *planters* generally think, for when once this is attained, and a strong and good flush, on the *insect* in the case of *blight*, having *more food* or *leaf* than he can destroy, a *less* loss is sustained by the planter, for he gets *more leaf*, on account of there being a *good* flush on by cultivation, and this alone, and being able to get *some leaf*, and that *unblighted*.

on than they can manage, the planter is able to get some *unblighted* leaf for tea, and a *less* loss is sustained by the planter than if he was unable to cultivate by *hoeing and picking* owing to the closeness of his planting.

Note.— The destruction caused by the *blight* insect is not merely the puncturing of the tender leaves which makes *indifferent* tea, but the very *buds* or *germs* from which the *new growth* springs, and from which we get the *leaf* for our tea, are blighted or attacked to such a degree, as in a *good many* cases, to necessitate *new buds* to form and burst (before a new flush can be expected), and this can only be got by cultivation, storing up, and turning over the soil.

Note.—For any one wishing to plant a garden to sell after a few years (when the quick returns have done yielding their utmost, on account of the closeness of planting the plants, impoverishing the soil sooner and no means of strengthening it, but by *manure* and not by *cultivation !*), why I say, plant as close as you like ($1\frac{1}{2}'$ × $1\frac{1}{2}'$); but if the proprietor wishes to retain the property for any time, and the yield to improve yearly, and

the garden not be worked or pumped out in a few years, why, I say, plant nothing less than 4′×4.′ Of course on teelah land, plant the *steeps* close 1′×1′ or 2′×2′, *across* the teelahs to check the wash, and retain the soil on the teelahs, but *not* otherwise.

P.S.—" A pick is a one-pronged fork, the iron portion *pointed* and *rounded* in order both to enter the soil and *not* cut the roots, as it would if the iron portion were *edged* in any way, *triangular* or *square*."

WITH reference to " Close *versus* Wide Planting," by LOSHAI, allow me to give you my *experience* in figures. I have no wish to argue with the writer of the above, but merely to state what I have *found* to be the difference between close and wide planting.

The plot is a 24-acre one on a dead level, 5,400 feet above sea. 12 acres were put out in 1864 5′ × 5′, and 12 acres in *same* year 4′ × 3′. In 1865 I filled in the first 12 acres so as to make the distance 2½′ × 2½′. Both 12 acres have been treated exactly alike as to hoeing and manuring ; manure has been given to both *every* year ; the pruning has been to suit each plant.

The 24 acres began yielding in 1868, but it is only since 1871 I have kept a careful account of the doings of each, which I now give :—

Acres.		1871. lbs.	1872. lbs.	1873. lbs.	1874. lbs.	1875. lbs.
12	2½′ × 2½′	3,108	3,685	3,858	4,546	4,332
12	4′ × 3′	1,744	2,132	2,522	3,123	2,987

Acres.		1876. lbs.	1877. lbs.	1878 to 31st August. lbs.
12	2½′ × 2½′	5,259	4,609	4,110
12	4′ × 3′	3,674	3,207	3,019

The plants are China in both 12 acres.

JAVA TEA, AND CULTIVATION IN JAVA.

BY E. M.

I HAVE been looking into the subject of Java tea. In appearance it is a very good looking tea, particularly small in "make" and well rolled. In fact the most perfect " make" of tea I have ever seen. But the liquor of all the samples I have tested are deficient in strength, and Brokers here in London say this is its character.

As Java sends home now a large quantity, and will probably send more as time goes on, it is likely to prove a rival to our Indian teas in the London market. Still, unless the teas infuse better than they do to-day, that is, give more desirable liquors, they will certainly never be employed for what Indian teas are principally used, *viz.*, to "*fetch up*" (the expression used by the Dealers) weak China produce.

I have lately got together, from reliable sources, notes of the cultivation in Java. They are not complete. There is more than one point on which I know nothing, but what I do know will interest, your readers.

It is principally as to gardens in Java on sloping land regarding which I have received my information. There is also cultivation there on flat land, but what proportions the two bear to each other I know not. As your readers are aware, the main difficulty on sloping gardens is " the wash." As this has been written about in all works on tea, I cannot do better than quote from one of them which sets out the case clearly :

" The first idea prevailing about tea was that it should be planted on slopes. It was thought, and truly, that the plant was impatient of stagnant water, and so it is, but it is not necessary to plant it on slopes in consequence. Pictures of Chinese, suspended by chains, (inasmuch as the locality could not be otherwise reached) picking tea off bushes growing in the crevices of rocks somewhat helped this notion ; and when stated, as it was, that the tea produced in such places was the finest, and commanded the highest price, intending planters in India went crazy in their search for impracticable steeps ! Much of the failure in tea has arisen from this fact, for a great part of many,—the whole of some; gardens—has been planted on land so steep that the tea can never last or thirve on it. This is especially the case in Darjeeling.

" Sloping land is objectionable in the following respects :—It cannot be highly cultivated in any way, (I hold tea will only pay with high cultivation), for high cultivation consists in frequent digging, to keep the soil open, and get rid of weeds, and liberal manuring. If such soil is dug in the rainy season, it is washed down to the foot of the hill, and if manure is applied at any time of the year, it experiences the same fate when the rains come. As it cannot be dug, weeds necessarily

thrive, and diminish the yield by choking the plants.

"The choice is therefore of two evils—'low cultivation and weeds,' or 'high cultivation which bares the roots of the plants in a twelve month.' Of the two, the first *must* be chosen, for if the latter were pursued, the plants, getting gradually more and more denuded of soil, would simply topple over in two or three years. But choosing the lesser evil, the mischief is not confined to the bad effects of low cultivation. Dig the land as little as you will, the great force of the rains washes down a good deal of soil. The plants do not sink as the soil lowers, and the consequence is, that all tea-plants on slopes have the lower side bare of earth, and the roots exposed. This is more and more the case the steeper the slope. These exposed roots shrivel up; as the sun acts on them the plant languishes, and yields very little leaf.

"Attempts are made to remedy the mischief by carrying earth up from below yearly, and placing it under the plant, but the expense of doing this is great, and the palliation is only temporary, for the same thing occurs again and again as each rainy season returns.

"The mischief is greater on stiff than on sandy soils, for on the former the earth is detached in great pieces and carried down the hill.

"A great many gardens in India, indeed the majority, are on slopes. A few in Assam, the greater number in Cachar, some in Chittagong, and almost all the Himalayan plantations. Such of these as are on *steep* slopes will, I believe, never pay, and instead of improving yearly (as good gardens, highly cultivated, should do even after they have arrived at full bearing) such, I fear, will deteriorate year by year.

"Plantations on moderate slopes need not fail, because of the slopes. The evils slight slopes entail are not great, but the sooner the fact is accepted that sloping cannot vie against flat land for the cultivation of tea the better.

"The lines of plants on sloping ground neither run up and down, nor directly across the slope. If they run up and down, gutters or water-courses will form between the lines, and much additional earth will be washed away thereby. If they run right across the hill, the same thing will occur *between the trees in each line*, and the lower side of each plant will have its root laid very bare. It is on all slopes a choice of evils, but if the lines are laid diagonally across the hill, so that the slope *along the lines* shall be a moderate one, the evil is reduced as far as it can be by any arrangement of the plants. No: I forgot, there is one other thing. The closer the lines to each other, and the closer the plants in the lines to each other, —in short the more thickly the ground on slopes is planted, the less will be the wash, for stems and roots retain the soil in its place; and the more there are, the greater the advantage.

"Where slopes are steep (though, remember, steep slopes are to be avoided), *terracing* may be resorted to with advantage as the washing down of the soil is much checked by it."

Strange, that with the extra work sloping land necessitates, and the smaller results it gives, while millions of acres of flat land in good tea climates were available, so very many gardens in India are planted on hill sides. The idea, first entertained when tea in India was a new thing, that the tea plant would *only* thrive on sloping land, did much towards this mistaken result. There were other reasons also, for instance, the wish to be in a temperate Himalayan climate. But I am wandering from my subject, which is to tell your readers how they cultivate tea on slopes in Java.

But the Java facts puzzle me. *If* the large produce is due to improved cultivation (whether heavy and special manuring, the whole system, or whatever may be comprised therein) how is it that the flushes are not more frequent? In other words, how is it that from 18 flushes they get nearly double as much tea as we do, as a rule, in India from 25 and upwards? Can it be due to the hedge system of planting adopted, and the consequently larger number of plants in an acre? Four × four (perhaps the most general mode in India) gives 2,722 plants, and 4×2 (the Java system) would give just double, *viz.*, 5,444 bushes. I have always looked with favor on the hedge system, though never bold enough to adopt it. There is much to be said for and against it, but I think the "for" preponderates.

As supposing the facts correct, and that from 18 flushes they get more than we do from say 25, notwithstanding a lighter system of picking, (to which latter the Java tea bears evidence), it is plain that each plant of their larger number, must, at each flush, give as much, if not more, leaf than the fewer plants we have to pick. Now the leaf-producing *area* of plants, 2 feet apart in the lines, cannot be so large as that of plants 4 feet apart. In other words, each bush is smaller. The equal, if not larger

produce, then, from each individual plant *must* be due to its flinging out a larger number of shoots on each square foot of the leaf-producing area, and this I hold *can* only be caused by the stimulus the bush has received from high cultivation of one kind or other.

Still, as I said, I am puzzled; for high cultivation produces frequent flushes, and this they lack in Java!

The plants are put in 4′ × 2′,—four feet of course between the rows, and two feet between the plants. Each line is therefore a continuous tea hedge. In the extract given above it is recommended to place the lines "diagonally across the hill, so that the slope along the lines shall be a moderate one," but they do not follow out this plan in Java. They run the lines there right across the slope of the hill. I believe the diagonal plan is the better, but the measures they take to prevent the wash does away with the objection.

Between the lines, 4 feet apart from centre to centre, holes are dug 2 feet long, 1 foot wide, and 15 inches deep. In the spaces or rows above and below, the said holes are opposite the sound portions. Every third row has the holes opposite the first; those of the second and fourth likewise agree. Thus, whatever wash there is must be caught by the holes, if not in the row where it accumulates, in the second, and necessarily no injury from the wash can take place. The earth taken out of the said holes is piled up, loose, between the holes.

As an extra precaution (because with heavy rain the holes fill and overflow), catch-water drains are dug diagonally across the hill, 30 or 40 yards apart.

Twice a year the holes are filled up, and new holes are made in the intervening spaces, so that virtually the whole of the soil between the tea hedges is stirred and opened out twice a year. The same thing is done where the land is flat, or nearly so; only there, as there can be no wash, the catch-water drains are omitted.

The advantages claimed for the plan are three-fold. *First:* no injury from wash can take place, inasmuch as the soil is not washed down the hill and the roots of the plants thereby laid bare. *Secondly:* the manure supplied is kept on or near the spot where it is laid, and sinking with the water into the holes, is brought into connection with the roots of the bushes. *Thirdly:* the whole of the soil, to the unusual depth of 3 inches, being, twice a year, exposed to the action of the sun and air, is a most efficient mode of cultivation,—may be styled, indeed, "air manuring," and tends to heavy flushes.

The plan, as described, is followed out exactly as detailed by the largest, and *on dit* the best tea planter in Java. He has, in his several gardens, about 1,000 acres under tea; and if "the tree is known by its fruit," the *modus operandi*, to be judged of by its result, we must conclude his system is a good one. From his 1,000 acres he manufactures and sends to the London market, in round numbers, eight hundred thousand pounds of tea: ten maunds tea per acre!

As the above is fact, it is certainly worth the while of Indian planters, at all events, to test the plan on a small area, and judge for themselves.

The system is however not a new one,—at least to me. I remember years ago, when I first went into tea in Kumaon, precisely the same thing was done on a plantation there, named, if I remember right, the "Lohba Garden," owned by a Captain Cumberland, since dead. I had a sloping garden in those days, and I did *not* adopt it. Perhaps I was wrong. Anyhow, it would be interesting to know if the practice has been continued at "Lohba" (I believe the garden exists still), and what the results have been. The produce per acre at Lohba I forget, but the teas I remember were *very* good.

I have never thought 10 maunds per acre as at all impossible. It has already, I know, been done on parts of gardens in India, but on the whole of a large garden, never yet. I hope to accomplish it on the gardens I work, as they are in a favourable tea locality, but they are young yet. This, merely to show that to my mind there is nothing improbable in ten maunds to the acre, off even one thousand acres.

I hear the said Java planter manures liberally also; but that he does not believe in chemical manures, for he holds their effect is not lasting, but uses animal manure and vegetable manure, weeds, &c., &c., alone. To manure, doubtless, he owes a part of his success.

They have one advantage in Java we have not in India. They can, and do, pick there all the year round, and of course to this also, in a measure, is due the large yield mentioned. The being able to do this is due of course to the Java climate,—there being no cold weather to speak of. Still, I thought the tea plant required a period of rest to hybernate.

One or two more words as to the Java system in other respects.

The weeds are all pulled up by the hand, and thrown into the nearest holes, where they lie and rot, and are eventually buried when the hole is filled up.

The tea plants are pruned and kept very low, never allowed to exceed 2 feet in height. This is, as all your readers know, considerably less in height than we allow the bushes to attain in India.

Every 40 days they pick what they call a "Big Flush." but even then they only take the bud and the two leaves below it. Twenty days after each big flush they take what they designate a "Small Flush," and at this time they only pick the top leaves of any shoots which, from their small size, had escaped when the big flush was taken.

Thus, in the year, 9 large and 9 small flushes are picked—18 flushes in all.

Like the Indian planter, his Java brother calculates four pounds of green leaf make one pound of tea.

This finishes my description, but I will add a few words as to the peculiarities and merits of the systems set out above.

Why is the liquor of all Java teas undeniably weak? I cannot fully answer this query. It may be due to faulty manufacture (though they certainly excel wonderfully in "make"); or, it may be due to the fact that the trees are picked all the year round—and get no resting period.

In India, in *forcing* tea climates, I have known 28 to 30 flushes per annum, against the Java 18. In India we generally take *more* than "the bud and two leaves," and anyhow we take at least this every flush. So much would argue a smaller produce per acre than is usual in India, and the one fact which would argue a larger, *viz.*, that they pick the whole year, is neutralised when we consider the total number of flushes,—in their case 18 in 12 months; in ours, above 25 in 9 months!

To what then is their large produce due? I cannot doubt,—I never did doubt,—that even on flat land the hole cultivation system, as described, must be very efficient, and tend to large produce. The question is, how far labour for it would be available for us in India; and, secondly, how far the increased produce would pay for the increased cost of labour? It is a thing to be tried: by doing so, we shall arrive at trustworthy conclusions.

THE HEDGE SYSTEM.

BY E. M.

In no work on tea that I have seen is discussed the advisability of "Tea Hedges,"—that is, of tea planted 2 feet apart in the lines,—which system is followed out in Java.

The following is an extract, however, which refers more or less to it. I quite agree with the opinions here expressed:

"Four feet is, I think, the best distance between the lines.*

"It gives space enough for air to cultivate, and to pass along, even when the trees are full grown.

"Where manure is obtainable, and the soil can be kept up to a rich state by yearly applications, a garden can scarcely be planted too close.

"I see no objection to trees touching each other in the lines, and advise therefore 3 or $3\frac{1}{2}$ feet there,—the former where the soil can be periodically manured.

"On considerable slopes, to prevent the wash of soil, the plants should be placed as close as possible,—say $3\frac{1}{2}$ between, and 2 feet in, the lines.

"A closely planted garden will grow less weeds than a widely planted one, and will consequently be cheaper to work.

"As the expenditure on a garden is in direct proportion to the area, and the yield in direct proportion to the number of plants, (always supposing there is power enough in the soil to support them), it follows that a closely planted garden *must* be very much more profitable than the reverse."

I have often in India discussed the subject of "Hedge Planting" (that is of plants placed so close together in the lines that they will form a continuous hedge, like a quickset hedge) with other planters. All such discussions have been theoretical, for on no plantations in India have I seen the plan carried out. I have always been in favor of the system, though I admit I have never been bold enough to reduce it to practice. But after taking into consideration the figures as to

* I think $4\frac{1}{2}$ feet on flat land.—E. M.

produce in Java, I think it very necessary to go into the point fully.

The objections against the plan advanced by its opponents are: (1), that bushes so close together in the lines (say 2 feet apart) have not room to develop, and consequently *cannot* give as much leaf as plants further apart; (2), that the tea shrub requires sun and air, and that, placed thus close to each other, they only get this on *two* sides; (3), that the roots run into each other, and occupy the same soil, and thus each individual plant only receives a moiety of the nourishment it is entitled to; (4), that the leaf-picking area of each bush is diminished, for, joining each other as they do, only two sides and the top are available. I know of no objections, besides these, which can be advanced against the system.

Were the object to produce the largest quantity of leaf *per plant*, the above objections would all be sound, and fatal to the system under discussion. But it is *not* so. The result sought is the largest quantity of leaf obtainable if per any *given area*, say per acre: so let us see, now, if what is set out above is really a hindrance to this.

Objection 1.—Admitted that plants thus close cannot develop as well as they would if further apart. But the smaller plants, on any given area, *may*, nevertheless, give more leaf for that area.

Objections 2 *and* 3.—Same may be said in reply to these. The bushes *will* be smaller, but the leaf per area *may* be more.

Objection 4.—I incline to the belief that, as the plant is prevented sending out new shoots on two sides, it will give birth on the other two sides and top (available) to all the new shoots the constitution of the bush inclines it to produce. In other words, the shoots which would otherwise have been developed on the *four* sides and the top, will in this case be all produced on the top and *two* sides. Further, in answer to the objection that the leaf-producing area is smaller, I admit of course it is so *per plant*, but the continuous wall-like two sides, and the continuous table-like top, produced by the Hedge System, would give, I think, a really larger leaf-producing surface *per acre*.

That each plant, owing to its proximity to others, cannot be cultivated all round; that is, that the soil cannot be opened out and stirred all round, is another argument against the plan of Hedge Planting. It is, however, only partially true. Though the soil cannot be *dug* between the plants in the lines, it can be more or less *stirred* with weeding hand-forks, while the absence of weeds between the plants in the lines, due to the complete shade, makes cultivation less necessary.

I also believe that in the Hedge System, the larger number of roots and rootlets would be thrown out by each plant on the two free sides, and consequently the nourishment would principally be drawn from the soil, which could be thoroughly cultivated.

All the above *pros* and *cons* apply both to flat and sloping land, but in the latter the resistance the bushes, thus closely planted, give to "the wash" is an extra advantage.

I know of nothing else that can be said either for or against the system. After what I have heard from Java, I purpose planting the tea in hedges on part of two gardens I am now making, and I advise other beginners to do the same. Whether "the whole system" as pursued in Java, should be adopted *with* the hedge plan, is a question which stands on its own merits.

I HAVE tried the system of "Hedge Planting" and will give you the results of my experience.

In 1873, I put out seedlings 9 months old at 4×2, that is 4 feet between the lines and 2 feet between each tree or seedling as it was then.

The land had been previously planted with coffee, but this turning out a failure, it was decided to uproot it and lay out tea.

The soil being rather poor, I trenched it to the depth of 18 inches *across* the slope, which is moderate; and not having any animal manure available, I filled up my trenches with *green jungle leaves*, and then proceeded to "hole" for planting out. The lines of holes were parallel to the trenches, and being only 2 feet apart were

consequently smaller than are usually made for 4×4.

The whole soil was thus well stirred on every part, and I laid out my plot very successfully in July 1873.

Nothing could have come on better during 1874, 75, 76 and 77, and in 1878 I tipped them at the end of the season. They were then about 3 feet high, and last cold season were given a top-pruning only. This year we had a drought lasting till May 20th, and no plants suffered so severely as the 4×2—in fact I thought they were done for. The whole plot was a mass of reddish brown coloured leaves, and any one seeing them would have considered them *dead*.

They did not recover till the end of July, and about 15 per cent vacancies are the results. They only gave five flushes from August to end of this season, and on the whole I am rather disgusted with my experiment. Other plots 4×4 of the same age did not suffer one quarter so much as the 4×2.

The worst of it is that my experience has shown me it is no use trying to fill up the vacancies, as a seedling of 9 months or 18 months will stand no chance among the remaining lot, and the plot will always be an eysore, with the great gaps in the hedges. Now, why did the plot in question suffer so severely in comparison with other plots of 4×4? All had the same treatment as regards cultivation. Of course with 4×2 you can only hoe between the lines and hand weed between the trees, all weeds being placed on the lines and dug in.

I quite agree with the Java planters running their lines *across* the slope of the hill, and their measures for preventing wash seem all that can be desired. Next season I shall keep an account of the flushes off the 4×2, and I will also take samples of the tea for testing as regards liquor, and compare with samples from 4×4.

I need hardly say that from what I have written I do not approve of 4×2 for *this district*. I am not prepared to say that it won't succeed in other Indian tea districts, but I certainly don't advise any one here to try it.

I believe 4×4 and 4×3 are the best distances apart for Hybrids, and 3×3 for the China class. I may add that I prefer a *slight* slope to perfectly flat land, and provided the former is not too steep, it can be cultivated as highly as flat land, without any loss of soil whatever. All my "slopes" are *terraced*.

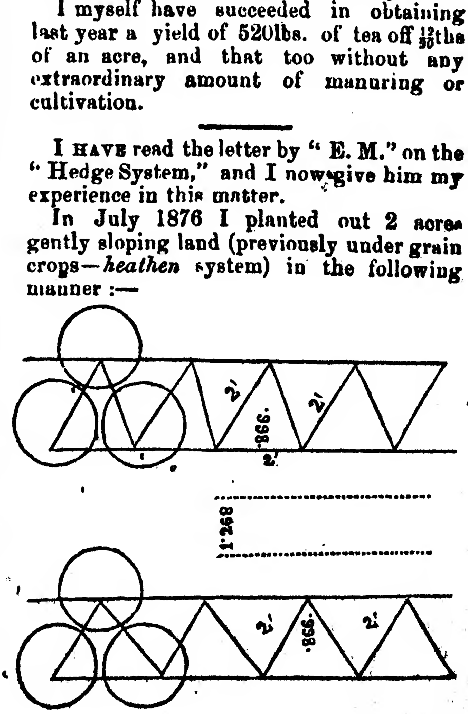
CHOTA NAGPORE. A. H. T.

YOUR London Correspondent "E. M." is desirous of knowing what the result has been of the Hedge System of plainting the tea bushes as followed by the late Capt. Cumberlaud at Silkote. I am not aware that Capt. C. planted more than 5 acres or so on that system, and this was done on a very gentle slope, where the wash was more great; while on the steep hill sides, where the bushes were planted on the 4-feet apart system, almost all the good surface soil, consisting of a rich vegetable mould, has been swept away. This I know from personal knowledge. Your correspondent "E. M." evidently forgets that he inaugurated the Hedge System of planting tea in Kumaon. At least I know I learnt it from him in years gone by; and all the tea I planted out subsequently, about 15 acres, was planted on that system. The rows run right across the hill slope, and the bushes form a continuous hedge. Between the rows, which are four feet apart, I run the common hill plough some 3 or 4 times during the rains: this serves to keep the weeds down, and moreover to prevent any great amount of wash,—in fact, I may say there is no wash. I also find that the bushes flush as often, and give as much leaf, as bushes planted on the 4 feet apart system.

I myself have succeeded in obtaining last year a yield of 520lbs. of tea off $\frac{12}{30}$ths of an acre, and that too without any extraordinary amount of manuring or cultivation.

I HAVE read the letter by "E. M." on the "Hedge System," and I now give him my experience in this matter.

In July 1876 I planted out 2 acres gently sloping land (previously under grain crops—*heathen* system) in the following manner :—



The circles represent the bushes arrived at 2 feet diameter, which is the average that bushes in this valley may be considered to attain. In some instances they grow to a much larger size, but I think I may safely say that the general run were, on nearly all the plantations I visited, in **1875-76**, far under the size I made allowance for.

From the diagram you will see that the area of land allotted for each bush is 5 square feet, *viz.*, half the intermediate open space for 1·268 ft.=0·634 ft.+1·0 ft. + half perp. of equilateral triangle 0·866 ft.=2½ ft.×2· diam. of bush=5 supl. feet, or 8,712 bushes to the acre.

In 1879 the plot so planted yielded 1,898lbs. leaf of 3 leaves and point plucked for green teas, or per acre 949lbs. leaf =237lbs. teas.

Another plot, about a mile nearer the mountains and in a better locality, planted 3′×4′ in the same year, shows 1·61lbs, similar leaf, or 265lbs. per acre.

Each of the above plots received the same number of hoeings, the same style of pruning, and the same quantity of manure *per acre*, so that the hedge-row bushes had only 2 seers each of manure, while the other had 5 seers each. This difference of treatment I could not avoid, though my intent was to have issued manure *equally per bush*.

The 3′+4′ plot had another advantage—it was virgin soil, and this, added to the greater quantity of manure, creates "elements of discord" in comparison of results.

I shall try to equalise as far as practicable the conditions for next year's comparisons by applying such quantity of manure to the "hedge-row" as shall make its allowance during the two years equal to that of 3′+4′ plot for the same period.

Up to the present, from the above, I can only infer that the yield *per acre* would have been the same in quantity had similar conditions of soil and manuring belonged to both.

With reference to *Hedge Planting*. If your correspondent plants "China," by all means let him adopt the Hedge System; it answers admirably.

If Hybrid is to be planted, let him be cautious, and give his mature plants sufficient room to grow freely,—say at least 4½ × 4 feet.

If Indigenous is to be planted, I advise him strongly not to waste his seedlings by planting them less than 6 × 6 feet, or he will assuredly be a loser in the end.

Watson's theory is doubtless the best, *i.e.*, cover your ground with plants, but let them be well developed,—not stunted close planting.

Such is the experience of one who is planting on his own account after an eighteen years' apprenticeship in tea.

Will any of your experienced or statistical readers subscribe their information, backed by experience and facts (not theory), on the following subject, *i.e.*, *line planting*, say 5 × 3. What direction should the main lines take from due East to West, or N. to S., N. E. to S. W., or N. W. to S. E. The information wanted to be elicited, which will ensure the best ventilation and action of sun and air, results will naturally follow.

I am an old planter, but not satisfied on the point. In the one case there would be a longitudinal sun throughout the lines E. to W. all day, the south side of the lines obtaining the greatest warmth and benefit. On the other plan, N. to S., each side is exposed alternately daily to the sun's action; but do the rays penetrate sufficiently to the lower parts stand roots? "I fear not, nor is the soil exposed to its chemical action through warmth."

Would either of the other alternatives be better? I incline to the opinion that from due E. to W. is best. Reliable information on the point would be generally useful.

Terracing.

There is now-a-days a great deal said in favor of terracing tea gardens. As this is a very expensive item in cultivation, and the idea is, comparatively speaking, so new, that the results, good or bad, are not generally known, I trust a few practical remarks, resulting from *experience*, will not be out of place. Let us first take round or flat terracing; this I have done previous to planting the land, making the terraces on an average 3 feet wide. Adjoining this piece of land another portion, having the same slope, was planted at the same time, and *not* terraced; the result was, that at the end of the first year the plants on the unterraced portion were at least half again as large as those on the terraced portion; the same amount of cultivation was given to both places, only that in that terraced the edges of the terraces were not hoed during the rains, and allowed to get hard in

order to preserve the form of the terraces. In the cold weather the plants were all pruned to the same height from the ground, and again the same amount of cultivation given in the second year: the result at end of second year was, that there appeared at least a year's difference in the ages of the plants, the unterraced portion having strong healthy looking bushes and quite double the size of those terraced. The third year also showed a far greater and still further improvement on the unterraced portion. Now what is the reason of this?

Again on an old part of the garden, say 15 or 16 years old, which formerly used to give a good average yield of leaf, terracing was adopted: the result was, that the bushes deteriorated, and did not give near the quantity of leaf they used to with the old sort of cultivation, *viz.*, deep hoeing, but at the same time only weeding the very steep portions; hoeing was carried on these terraces also, and only the edges of the terraces left unhoed. The only reason I can attribute to this is, that the ends of the lateral roots never receive any cultivation on the upper and lower sides when a wall of hard soil is left to remain, and on the lower side instead of the roots (laterals) being able to extend further (owing to the cutting of the terrace together with the hard soil left), they are thus forced to take another direction, and the health of the plant is injured by their doing so.

What I mention above, *viz.*, the diminished yield, I have by terracing not only seen proved in one place but on many over parts of the same garden; also in other terraced gardens I have observed that the sides of teelahs rarely contain as good plants as you see on the flats, whereas on unterraced gardens, let them be old or young, I have often noticed the teelah portions in every respect equal to, and in some cases even better than, the flats or table lands.

As I am sure terracing is a great deal founded on theory, I would be glad if any one could show me from experience and results how benefit from terracing a garden is to be derived.

Probably some will say that the earth is kept on the teelah by so doing, and that benefit to the plant must be had from that earth; but where is the benefit, and what is the use of having the earth on the teelah if you get no good from it? It would be far better perhaps to hoe that same earth in and mix it well with other soil on the teelah, together with what grass and small jungle will grow more regularly on an unterraced garden, and thus always be forming new soil. True, you see many old worn-out gardens where bushes are standing on pinnacles of their own, the earth being washed away from all round them; but this would not have occurred had a little jungle (grass) been allowed to grow on these teelahs: it would have as effectually stopped the wash of earth as the bush itself stopped it.

Again, as a reason for the short yield of terraced teelah compared with those unterraced, it may be necessary for good drainage on a teelah as well as on a flat: now we make our terraces so that the water cannot run off, especially when we make the honeycomb terrace or pit terrace, which is a regular receptacle for water, and I have noticed the same yellowish appearance of the leaves on terraced teelahs as I have on wet flats, resulting from stagnant water.

SYLHET.

THIS expensive, highly ornamental, theoretical, but not practical sort of cultivation is now carried on on new gardens to a large extent. In the tea district of Sylhet the *honeycomb* terrace is chiefly adopted, and this, of the two sorts of terracing, is the most ruinous to a young garden.

In this sort a long pit is dug between the lines, the pit extending across the slope of the teelah, and when the face of a teelah is terraced it has something the appearance of a honeycomb; these pits are suffered to stop the wash or rush of water down the face of the teelahs in the rains, and thus save the soil from

being carried down with it, and they are generally made on teelahs with sandy soil.

Now, by making this sort of terrace on a sandy teelah especially, the earth and soil are taken away from either side (upper and lower) of the plant, and it is left growing on a bund as it were, with nowhere for its side roots to extend; in the hot sunny weather the roots of the plants suffer from drought. If we loosen the soil about the plant on the bund (between the two pits where the plant is,) the sides of the pits being steep, the probability will be that nearly all the earth will tumble into the pit, so that the only cultivation we can give to a teelah thus terraced, is to again throw up on the bund whatever soil has been washed off it into the pits by the rain: this is really no cultivation at all, and the plant suffers more on a teelah of this sort than it will on a flat where it never sees a hoeing, as on the flat the roots are kept cooler and allowed to spread; on the terraces they can't, and are parched. At other times, during heavy rains, the water lies in these pits and thus again injures the plant, round which we know if the water lies on a flat it will prove detrimental.

On the *round* terracing also, though not so injurious as the *pit* terracing, we cannot give proper cultivation, and weeds and sungrass are apt to get in on the edges, which are not hoed so as to preserve the terraces; then weeds (sungrass) spreads so quickly that in one year it will, if not rooted out, increase hundredfold or more, and where only a few weeds were at the commencing you will probably find the greater portion of your teelah covered with it in a year or so—thus impoverishing the plant with its roots and stopping your plucking considerably, so shutting out light and air from the plant.

This sungrass may not appear at first for a year or so, but eventually you may be certain it will appear, and we have then, in order to get rid of it, to cut down our terraces and extract all the roots to kill it. And this operation has to be done twice or three times in the year to fully eradicate it; we have then again to prepare terraces if we want the teelah to look ornamental. I therefore maintain that by hoeing a teelah, say three times in the year, and allowing a little grass to grow between each hoeing, very little if any soil is lost. The teelah should be hoed across the slope, and hoed in the cold weather, say February, in the middle of the season, and again at the end of the season, and the bushes will be found to thrive and give a far larger yield per acre; the grass being hoed in with the prunings acts as manure and renews the soil. In the first place the bushes should be planted close, say $3' \times 3'$ or $3' \times 2\frac{1}{2}'$.

On very steep places a careful hoeing can be given once or twice in the year, but not oftener; bamboos, *ekara*, if procurable, may be laid across the teelah behind the stems of plants, and this with the weeds placed against them forms a very good wall to any earth being washed down, and should cost hardly anything.

At next year's hoeing we can put others down in different places, and so be able to hoe where the *ekara* or bamboos were previously, as well as where we now place them, and no soil is lost nor does the plant suffer from weeds under cultivation, drought, or too much moisture.

On old gardens we generally see the bushes standing on pinnacles, especially on sandy soil gardens, but not very often in stony or other good alluvial soils, notwithstanding the 16 to 20 years they have been planted.

The pit terracing partially does in one year what it has taken 20 to do naturally by the rain, as by making these pits we place the plant in a bund, and deprive it of its proper quantity of soil or manure.

PART II.—CULTIVATION.

ON THE EFFECTS OF CULTIVATION.

BY C. E. M. RUSSELL, M.R.A.C.

AMONG the means at our disposal for improving both the mechanical and chemical aspects of the soil, the one which is at once most generally known and most ancient, is that of *Simple Cultivation*, or the breaking up and exposure to the atmosphere of that portion lying immediately below the surface. This, however effected, whether by the plough of the English farmer, the spade of the gardener, or the hoe of the tea planter, is universally recognized as an essential operation; and if we investigate the *results* of this simple cultivation, we shall see that they may be divided into two great classes, *viz.*, the *mechanical* and the *chemical*.

The former of these, *viz.*, the *mechanical*, deals with the comparative size of the fragments or ultimate particles of which the soil is composed; while to the latter, *viz.*, the *chemical*, relate those important changes in the quantity and comparative solubility of the mineral matter contained,—whether useful as plant-food, or prejudicial as injurious to vegetable life.

The great agencies of nature to which these results are due, are ever going on in some degree, so as to benefit us, whether we will or no; but by cultivation we can facilitate and intensify their action, and so gain from them to the fullest extent the blessings which they are able to confer upon the intelligent agriculturist. Take, for example, the case of ordinary *deep-hoeing* as pursued at least once or twice in the years on all tea gardens, and consider what happens, and what great revolutions are brought about by this simple and ordinary operation. Primarily, the soil, to the depth of some inches, is inverted, and by this inversion the weeds are destroyed; this is the simple and evident result; but let us enquire more closely into the others, some of which are only visible to the eye, in the improvement in the appearance and yield of the crop which they effect. By the loosening and opening of the substance of the soil the atmosphere has free access to a considerable portion, acting as a reservoir of plant-food: by the inversion of as much earth as a double stroke of the hoe can compass, the under portion is placed uppermost, principally, when in moderately tenacious soil, in the shape of large clods, and the action of the atmosphere upon the exposed portions is to crumble them down into a state of fine division; or "fine filth," as such a condition is termed by the English farmer. Upon this *mechanical* condition of openness and fine filth, many important *chemical* changes depend. The finer the state of division in which exist the particles which compose the soil, the greater the absorptive powers of the latter, both as regards the manurial gases brought down in a state of solution in the rain, and the carbonic acid gas as it is vulgarly, but erroneously, termed, *i.e.*, the carbon dioxide generated by the decay of vegetable matter within the soil. Now this decay of vegetable matter and consequent evolution of carbon dioxide cannot take place in exclusion to the oxygen which forms so large a proportion of the mixture of gases which we call the atmosphere. Although plants feed largely upon this carbon dioxide from the atmosphere, which they absorb by the stomata or mouths distributed over the surfaces of their leaves, it is as yet uncertain whether they do, or do not, absorb it in solution by their roots; but this point is comparatively unimportant in speaking of the action and use of this gas in the substance of the soil, as it has a separate and very important influence as a preparer of plant-food, inasmuch as, when in solution, it has a very useful solvent action upon the mineral constituents which are re-

quired by the plant for the formation of its structure. The finer the state of division of its component particles, the more water can be held, by the soil—not in a harmful stagnant form, but as what is termed *water of vegetation*, that is to say, the water entangled between the particles, the water upon which the plant is dependent in a drought, and of which no soils, however apparently dry, are ever entirely devoid.

The oxygen of the atmosphere has also an important influence in rendering certain useful mineral salts which are insoluble, and therefore incapable of absorption by the roots of plants when in their lower oxides, soluble by further oxidation; and of rendering certain poisonous salts of iron, very soluble in their lower oxides, insoluble by further oxidation, and it has thus a double action as a preparer of plant-food on the one hand, and as an annihilator of substances prejudicial to plant-existence on the other. Further, its influence is to purify and sweeten soils rendered sour by the presence of the various acids of vegetable decay, and to destroy mildew and moulds.

Drainage, though but very little understood by planters, is a very important operation in the cultivation of tea. Through the lamentable ignorance upon this subject which is displayed by some of the planters on the nearly dead flats of Assam, I have seen parts of a garden where tea, though repeatedly planted, would not, and indeed could not, grow. I have noticed stunted bushes, with their bark perfectly covered with lichen, which, though itself no cause of disease, is a sure sign that the soil is cold through the presence of a superfluity of moisture, and that, as a result of this, the vital juices of the plants have been chilled and caused to stagnate, the bark has thus become diseased, and in its diseased condition has afforded a suitable resting place to the lichen.

In Sylhet, drainage becomes a very simple matter; indeed most of the country appears to enjoy a perfect natural drainage,—at least as far as many planters appear to understand its action. The real fact, however, is, that the sole use of artificial drainage lies in the removal of stagnant water from land *visibly* suffering from a water-logged condition, and most, if not all, soils may be vastly improved by a judicious system of drainage, varying in its best methods of performance with the characters and several combinations of country, soil, and subsoil.

The *effects of drainage* may thus be briefly summed up: *Firstly*, soil, which from its surplus moisture was sour and unapproachable by the atmosphere, becomes sweetened by the access of air, and admits of the chemical operations above-mentioned under the head of *simple cultivation; secondly*, the removal of the surplus moisture, which by evaporation kept the internal temperature down to a very low degree, causes a much higher temperature to succeed the previous cold condition of the soil; and, *thirdly*, where an excess of soluble salts in the soil gives rise to an incrustation upon the surface by evaporation of the stagnant water holding them in solution and bringing them with it by its continual flow upwards through capillarity, the removal of such stagnant water *from below* entirely prevents a recurrence of this condition, while the drain remains in working order.

In commencing to drain, therefore, the first points which should occupy our consideration are, the level of the nearest river, bheel or rice land, in the cold weather; and also in the highest floods. The next object is a suitable outfall, from whence the system should be commenced, beginning with the main drains, and proceeding after their completion with the arterial. A little more attention to this most important operation would soon prove its inestimable value to the tea planter.

Liming is another of the methods at our disposal for the improvement of the soil; and, although in many districts the cost which has to be incurred precludes the possibility of

its profitable use by the planter, yet, in others, it most certainly would amply repay the necessary outlay. I have as yet heard of its employment upon but one garden (or rather one management) in this district, and the results of its application appear to have been eminently satisfactory. This operation is one which holds a secure position in British Agriculture at the present day, and is recognized as indispensable in the ordinary course of cultivation.

Upon newly-reclaimed lands in England, before any crop is sown *lime* is applied : its action is manifold ; it is itself a direct plant-food ; it assists oxygenation ; and hence, when in access to the atmosphere, hastens the decay of vegetable tissues, besides neutralizing the pernicious acids of vegetable decay, of which *humic acid* is the one most commonly known. Another action, which is due to its power of oxygenation, is the liberation of insoluble mineral matter, which is, so to speak, locked up out of the plant's reach. Mechanically, lime being intermediate in texture between sand and clay, is capable of improving either extreme ; and it is found in practice that its application can rid the soil of insects injurious to crops. Upon the great reclamation of an enormous tract of moorland in his county, the Duke of Sutherland was, when I visited the operation in July 1875, employing lime to the amount of 3½ tons upon every acre brought under the plough.

The soil of which I speak, however, was organic or peaty, and it is probable that a smaller amount would suffice. The one objection which can be urged against lime is its power of liberating ammonia. This, however, is not a serious one, as the amount of ammonia in the soil is not, as a rule, very appreciable, and the counter-balancing advantages of its use are very important. In use, the lime-stone should be burned upon the garden and applied to the land in the state of its greatest activity, *viz.*, in its caustic condition as quick-lime. It should then be hoed in when it will rapidly absorb moisture from the air and become slaked. In this change of its condition its volume will be increased, and the result will be to cause the top-soil to assume a more open condition, and thus to assist in its aeration.

One more point which should be referred to, but which cannot be called an effect of cultivation, as it is in fact nothing but a result of gross mis-management, is the unnatural absence in the soil of organic matter caused by the removal of grass, etc., if it has been allowed to attain a height sufficient to render it of use in building, littering-cattle, etc., from a cultivated portion, which, from some labour difficulty, has been insufficiently cultivated ; and through the removal of the prunings of the tea-bushes by the coolies for use as fuel. This is an entirely unnatural condition, and is only visible on an old garden which has been badly managed. The real effect of cultivation, provided the crop raised is a heavy one, and is not all removed from the soil, is to increase rather than to diminish the amount present when cultivation was commenced ; but of course the increase in the case of such a crop as tea cannot be so great as that in the case of land in jungle, and we should consequently be particularly careful in providing against the necessity of the removal of any organic matter whatsoever beyond our actual crops from the cultivated portion of our land. In practice the application as manure of vegetable mould from bamboo, and other jungles, has been attended with the greatest success. For the above reasons it is, when practicable, far preferable to avoid burning vegetable matter, and simply to leave it to decompose in the soil, and to yield the rich mould which is so useful an agent in the absorption of moisture and the lightening of the soil. Further, by the burning of vegetable matter, the volatile portion escapes and is lost, and the ash alone remains : the nitrogenous compounds, instead of returning to the soil whence they were derived, are rendered useless,

and return to the atmosphere from which they primarily came to enrich the soil.

The *colour* of the soil greatly affects its relative heat-absorbing power—the darker the colour the higher its temperature; vegetable mould is very dark in colour, and consequently will raise the temperature of a soil which is itself of a lighter colour.

From all of the above considerations, it will appear that the benefit to the soil *mechanically* of the internal decay of organic matter is one which cannot be over-estimated; and, if we admit this, we shall, I think, do all in our power to encourage a condition so highly favourable to ourselves.

Hoeing.

The practical effect of hoeing a garden monthly is to keep it clean and to force the tea bushes to throw out flushes. If any one could inform us, planters, how the stirring up of the soil acts on the growth of the plants, we might take an intelligent interest in the cultivation of the ground. As the habit of the China bush is small and shrubby, the roots must feed near the surface, and be greatly affected by the weather; they grow in accordance with the growth of the plant above ground, and cannot descend far, because of the necessary pruning. When manure is applied in the usual manner, the roots must be still more drawn towards the surface, to feed on the manure.

When there is labour enough on a garden, it is usual to hoe it once a month with heavy hoes, which must inevitably slice off the surface roots. Will some one favor us with their opinions as to the *rationale* of cultivation, and say why the ground should not be stirred up by pick-axes or forks, which would not do so much injury to the roots of the plants as hoes do; and whether it is better to have a well-stirred up garden with a slight coating of grass without wash, as is the case when the garden is forked over, than to have a clean, hoed, garden baked by an Indian sun, after the surface has been smoothed by the rain and wash? And does deep cultivation, say 9 inches, for the sake of allowing the moisture to descend, compensate for disturbing the roots when the bushes are growing? If the garden is lightly forked over in the rains, would it be necessary to turn up the under-soil in the cold weather?

Red Spiders attack clean and weedy gardens, seedlings and mature plants, indiscriminately, and more particularly after a drought or a continuance of cold wet weather, when the bushes are feeble; they also appear to attack early pruned and early plucked bushes first. The manager of a large garden near me arrests the progress of the spider by splashing the bushes well with liquid blue clay or mud, thus imprisoning the spiders for a time; and if the weather becomes favorable, the plants may recover their vigour and escape further attacks of the spider during the season. He is also of opinion that the mud or clay acts as a manure.

For the prevention of spiders on old gardens, the salt and substance that we have been extracting from the soil for the last dozen years, must surely be returned to the ground by a chemical manure. Cow-dung is so scarce as to be only available to renew some of the worst parts, or for some of the show parts of the garden: it is said that the cattle manure does not satisfy the requirements of the tea plant. Oil-cake, which can be had in abundance, has got into disrepute in some cases, because, being a stimulating manure, it requires to be applied annually if once begun; it is said to increase the yield by about a maund per acre, at a small cost, but if discontinued, the dividends decrease.

Dash.

With reference to "Dash's" letter,

when the soil is open (as after a good hoeing), it absorbs carbonic acid from the atmosphere, and if there be weeds the clod of earth ought to be turned over so as to bury them; these rotting let loose carbonic acid, which coming in contact with the soil forms plant-food, which, but for the carbonic acid, would not have been available. Land, therefore, requires deep hoeing often. If done with a hoe, a big clod is dug up, which, in stiff soil, takes a lot of rain to wash down: besides, the roots are frightfully cut; whereas a fork loosens the soil, admits air and moisture, and does not injure the roots to such an extent. No garden ought to be allowed to remain smoothened and baked by an Indian sun for any length of time. In the cold weather, from 15th December to 15th January, every garden ought to get a deep forking, and be allowed to remain in that way until the 1st February, when the clods should be broken, and all smoothed down, when the plants will show the benefit derived.

I WAS pleased with the commencement of DASH's letter, for it settles the question,—the importance of weekly digging, so much doubted by some. The question raised by DASH is this—Cannot hoeing be done better by some other instrument than the present clumsy instrument? Tipping the surface-roots with a knife once a year does not do damage if judiciously done, but if the surface-roots are systematically taken away once a month, I fancy great damage would occur. Supposing these were not hoed away, but eaten off by a grub: trees so attacked stop flushing *at once;* and this state, although the grub may be killed, very often continues to the end of the season. Certainly, hoeing is not practicable in thickly-planted lands. If DASH will take the trouble to use the *English fork*, not the kodalee fork, he will be able to dig deep and well. There is trouble always at first, but the garden year by year comes beautifully into order. By thick planting, judicious pruning and plucking and digging, two of my gardens of 35 and 25 acres respectively, gave, in 1875, 11 maunds of tea per acre. Cow-dung is very good, but DASH says that he cannot get enough of it. Oil-cake, he says, has got into disrepute. Most likely it was not the fault of the oil-cake, or the tea-tree, but that of the manager, who, because he had manured, thought that he could pluck everything off. No manure will enable the tree to stand *unmerciless plucking.* The same manure may not always give a good result. Manuring should be changed, or a compost made. Trees manured with cow-dung this year should have oil-cake next, vegetable mould next, bone-dust and so on: simply to change the position of the soil over the roots, and to bring fresh food for the plants; for they are like an oyster—they cannot go beyond a certain distance in search of food: it must be brought to them. This is the reason for a light hoeing or forking. Deep digging, I believe, is necessary twice a year—once in April, or May, and again at the break up of the rains—September and October; to prevent the earth caking round the roots of the tree in the cold weather, and so preventing them from acting.

IN many gardens there are plenty of weeds: the Manager does not know how to get rid of them; they are pulled or dug up, made into a ball, and chucked down the khud, with as much fine vegetable mould at the roots as possible, so as to carry the jungle further. Of course, the garden is quite denuded of good vegetable mould, the roots of the trees become bare, then canker shows itself, the trees become yellow, and give no flushes; in other words, it is *bhanji.* Then comes high cultivation. The retiring Manager determines to leave the garden, apparently in tip-top order. It is dug anyhow, but quickly.

If the new Manager is sharp, and examines, he will find all the jungle buried on the surface of the soil, the earth taken from the roots of the plants round about, to bury the jungle. In the cold weather it all appears level, but at the first rain it begins to sink close to the trees, and all the drainage from this sour jungle is towards the plant. The first flush is all right, but as the evil takes time to develop, the damage done generally shows itself in the second flush.

Again, to manure close to the stem of a cabbage is all right, and to take care that the *talee* is well stirred; but the tea-tree is not a vegetable: it really is a tree, and will grow 20 to 30 feet like a poplar, if left alone: it has a tap root. Is it right that water—let alone sour water—should collect in large quantities at the bottom of the tap root? If so, why not plant a tea-tree in a marsh. The manure washed out of the cattle sheds may have been sound, though weak when used, but from the manner in which it has been used it may become sour in the

ground. I appeal to fruit-tree, ornamental, and forest-planting gardeners as to whether it is right to let the water into the tap root, or to dig near to any tree. Watch a gardener in a Shrubbery: he digs a little distance off; he throws a little earth to the foot of the tree, and then lightly, but firmly, presses the soil close to it; taking care not to make an impression in the soil, so as to collect the water there.

Coolies are continually shifting from garden to garden, and Managers have continually, year by year, to be school-masters —I may say every year, to their dying day; and it is necessary for them to watch every stroke of the fork or *kodallee.* It is not only necessary to throw earth to the foot of the tree, but to press it down; for the simple reason that the incessant drip causes the soil to wash away; and on hill sides, more than in the plains. So, to the planter's astonishment, there is often a hole close to the tree, which he cannot account for.

I HAVE known, the soil. on being turned up after the rains, positively to stink of sourness; hence the Tirhoot indigo planter ploughs eight times to sun and purify the soil; but the tea planters think once enough. To dig in the cold weather, in the hills, is not sufficient; for the sun's rays are weak in December and January. March is one of the best months to dig, so as to sun and purify the sour earth, and should be carried on all through the first flush, through April, May, and June: in fact, the gardens ought to be dug once a month.

PRUNING AND PLUCKING.

BY A. B. S. E.

(I.)—Pruning.

PRUNING is perhaps the most important of all the out-door operations on a tea plantation; and if the literature treating of that operation is to be taken as a true index of the progress made in that particular branch of tea cultivation during the last thirty years, it certainly cannot yet be considered to have reached a high stage of perfection.

It is a fact worthy of notice (although hardly to be wondered at) that scarcely any two men who speak of, or have written on, the subject, have the same or even similar ideas regarding the proper performance of that operation, and that in practice they differ quite as widely regarding it as they do in theory. In proof of this assertion I shall give a short description of the various methods I have seen practised; also, if possible, a synopsis of the opinions held by one of the oldest, and one of the latest writers who have treated of the art.

First.—The mere tops of the bushes clipped or cropped with a knife or shears, and that more by way of giving the bush a neat appearance than anything else.

Second.—A two-foot rod placed in the centre of the bush, and no matter what the habit or character of the wood of which it was composed, thick and thin, good and bad, all reduced to the two-foot standard.

Third.—A part of the thickish scrubby wood taken out of the centres of the bushes, and that left, getting a general dress-over.

Fourth.—The centres cut completely out, and only a cup-shaped ring of scrub left.

Fifth.—A modification of the last, which consists in leaving the ring of scrub flatter, and more saucer-shaped than the above.

Sixth.—Every twig and branch in the bush cut back more or less. The leading idea of this theory of pruning evidently being the removal of everything green—stick pruning I think it is called. Bushes recently operated on seem only bundles of bare gnarled sticks, rather unequal in length and thickness.

Seventh.—Bushes get a dress-

over and have the thick wood taken out, no matter whether good leaf-bearing wood or not; the mere fact of its being a little thick, or the thickest in the bush operated on, being judged quite a sufficient reason for its removal.

Eighth.—Comparatively young as well as old bushes cut down to within a foot or fifteen inches of the ground.

Ninth.—And last, of what has come under my own observation, consists in the removal, as completely as possible, of wood that has become scrubby on account of age and hard work. Also of wood too weak ever to produce good leaf-bearing shoots.

All the methods here enumerated I have seen tried and have myself tried, but most of them only to a very limited extent. I shall now shortly point out what I consider objectionable and what advantageous in each; and detailed reasons for approval or disapproval will be given further on.

The method of pruning first described requires no particular notice. It makes very handsome showy bushes, but most unprofitable ones, from the great amount of scrub and weak worthless wood they contain.

The second is perhaps a slight improvement on the first, but as it makes no distinction in dealing with wood, whether young or old, scrubby or free-growing, it requires no further notice.

The third, under particular circumstances, answers well. For example, in dealing with old scrubby bushes, having scarcely any young wood, it is perhaps the safest method that could be adopted, as it gives no severe shock to the nutritive system of the plant.

The fourth removes what is good, leaves only what is worthless, and huddles all the young wood into a bundle in the centre of the bush, so that, through overcrowding, the shoots ultimately destroy each other.

The fifth is almost equally as faulty as the last—better only in respect of the ring of scrub being smaller and flatter, and the tendency to overcrowding in the centre of the bush a little less.

The sixth may be characterized as the bare-pole system, and is no less barbarous than ugly. It, with the two preceding, are, I believe, indigenous to some parts of Assam.

The seventh requires no special notice, as it recognizes no difference in the character of the wood operated on, save thickness.

The eighth is terribly severe, and ought never to be resorted to save in extreme cases, where bushes are old and excessively scrubby, with scarcely any appearance of young wood at either the top or bottom: under such circumstances cutting down may be permissible. But if plucked at all, the same season, unless sparingly and judiciously done, within the course of a very few years, their second state will be hardly better than the first; and if the same process be repeated and re-repeated, the time cannot be far distant when there will be nothing more left to cut. However, if the bushes are in a decidedly bad state of health, *i.e.*, with a considerable amount of dead wood, and the foliage of a sickly yellow colour, cutting down is certain death: death at least for all practical purposes. If the old stumps do make an effort to break (they generally do so,) still the effort is only comparable to the final flare-up of a burnt-out candle; darkness follows the one, and death as surely the other. Cutting down an old unhealthy plant with the view of inducing vigour and a better state of health is, on the part of the tea planter, as barbarous and

unscientific a procedure as it would be on the part of a surgeon to remove either the lungs or stomach, when seriously diseased, with the view of effectually curing his miserable patient.

What may be the immediate or proximate cause of death in an unhealthy tea plant that has undergone the operation of cutting down, is difficult to say; and merely to say that a general shock to the entire nutritive system is the cause, explains nothing. However, the parts of the individual plant that first suffer after cutting down, are the young rootlets, which consist of soft cellular tissue (the mouths of the plant), and the disease, followed by decay, travels upwards until it reaches the collar or life, knot—the point from which roots and stem diverge, the one up, and the other downwards; after which, all that remains is the dry sapless stump.

Whether the immediate cause of death be from some sort of erosive or fermentive action by the crude undigested sap (consequent on the removal of the organs of respiration and digestion), on the delicate walls of the cells and vessels composing the points of the rootlets, or whether something altogether different, I cannot say. However, there is no room for doubt about the main fact. It is not asserted that every plant in a field of tea so treated will actually die, although a number certainly will; and a considerable number will, for all practical purposes, be no better than dead, as they will yield no leaf, or only a miserably small quantity. If old plants, even although bare of young wood, are in a moderate state of health, they will bear close cutting down, without showing any great amount of mortality from that operation. But if decidedly unhealthy, and the state of health be not somewhat improved by cultivation previously, close cutting down will effectually save all further trouble and thought about them. Nor need it occasion any surprise, when it is kept in mind what the state of health is, that such a seemingly trivial operation should altogether destroy life, as a withered or diseased top is a sure sign of a co-extensively diseased root. I have been told that no surgeon cares about performing a capital operation on an unhealthy broken-down subject, as when the nervous and reparative energies of the system are reduced to a very low ebb, the chances of a good recovery are small; and so probably in a tea bush, with the reparative energies in a very low state; and then having the whole of the digestive and respirative organs removed at one swoop. The only wonder is, that deaths from injudicious cutting down are not far more numerous than they really are. And unfortunately it seems to be pretty generally believed that, in order to make an unhealthy bush healthy, all that is necessary is cutting down: as if that must prove an infallible cure for all the ills that afflict the poor old tea bush.

This practice of cutting down I shall next look at as affecting young plants that have become weak, twiggy, and scrubby,—not on account of age, but through bad usage and overwork. To think of improving the condition of such merely by the operation of cutting down, is a stupid mistake. After cutting a moderately healthy branch of a season's growth or more, from immediately below the point at which it was cut, there are generally two or three shoots produced, not one of which will have the same vigour as the parent branch if the whole be allowed to grow; but if all, save one, be removed, it becomes

equally vigorous and robust with the branch from which it has its origin. So, cutting back weak twiggy wood is only intensifying the very evil it is meant to cure; because every branch cut back produces two or three other branches, and all weaker than itself. So, if there is to be any real improvement, there is only one method possible by which that can be accomplished, *viz.*, thinning out instead of cutting down,—in short, the only thing which can be done that will be of real benefit to a tea bush full of weak twiggy wood.

The ninth and last mode of pruning to be noticed is the oldest that the literature of tea cultivation makes us acquainted with. Not that I regard that as any peculiar merit, but being myself a little conservative in some matters, this old plan of Jacobson's, so moderate in its pretensions, and conservative in its tendencies, is very much to my taste and liking. But whether this system succeed or fail, time and experience will alone determine: however as yet it has had no very extended trial by any of our Indian tea planters; and one thing at least can be said of it that cannot be said of many of the others enumerated, *viz.*, it does not discord with any of the established facts of Vegetable Anatomy or Physiology, nor yet of scientific horticulture. With pruning, in the modern sense of the term, it seems to have little or nothing in common; it is merely a thinning and regulating of the branches of the tea bush. So thoroughly conservative is it in theory that it professes to deal only with such members of the bush as are useless on account of weakness, age, and hard work, and to collect anew and turn into productive channels the leaf-producing energies that have been dissipated by continuous plucking. Some would have us believe that the knife to the tea bush is much like a tonic to the animal system, but this old-fashioned theory does not pretend that the knife exercises any occult influence as a stimulus to the production of leaf; but seeing that scrub is an evil inseparable from repeated plucking, it merely recognizes in the knife an agent by which that may be temporarily got rid of. I have seen somewhere a rather ingenious theory regarding the effect of pruning. The writer tells us that "pruning acts as a stimulus to the flushing power of the tea bush." That it may act so is probably true, but only in a very peculiar sense. The removal of a diseased limb, acting as a continuous drain on the vital energies of some unfortunate branch of humanity, may be the means of restoring the sufferer ultimately to a moderately fair state of health: so perhaps, in exactly the same sense, pruning may be a stimulus to better health and greater productiveness in the case of a scrubby, twiggy tea bush: but certainly in no other. Keeping steadily in view the origin and character of the evil we have to deal with, it is clearly evident that to that class of scientific pruners who, by the aid of a twenty-inch rod, and a tool, by courtesy called a knife, reduce all wood, whether young or old, robust or weakly, scrubby or twiggy, to the same dead level. Jacobson's plan, both in spirit and letter, is thoroughly opposed. Physicians, I believe as a rule, never pretend to affect cures, but only profess to assist Nature in doing so; and if tea planters would only adopt the same rational method in their treatment of the tea bush, the success attending pruning would be greater than it hitherto has been. If, instead of resorting to unscientific mutilation with the view of restoring to vigorous

health what has been broken down by vicious plucking and capricious pruning, they would try what effect better cultivation, careful plucking, and judicious thinning would have, that would be a step in the right direction. Be a little more conservative in using these magical knives, some of which seem specially designed for the purpose of mutilation, from the slovenly-jagged rat-eaten-like appearance of the cutting done by them : cut only when necessary, and no more than is necessary, and better health, manifesting itself in increased vigour, will be the direct result. It would be well to bear in mind more frequently than is done that the final end of the tea bushes' existence is not merely the production of leaves to be converted into black tea, but, like every other living thing, the development of the individual for the continuation of the species. However, as the tea bush must live under artificial conditions, in order that it may suit our purpose, it does not exactly follow that any interference with the function of reproduction must necessarily impair vigour or shorten life ; in fact, the very reverse is the case, as the suppression of the reproductive increases the vigour of the nutritive function : which is the point we wish to get at. And the only manner in which this transference of the energy can be accomplished, is by a judicious use of the knife in the removal of old scrubby wood, with a tendency to produce flowers and fruit, and by so doing concentrate in young healthy wood the whole energies of the root system of the plant. Such seems to be the end to which all our treatment of the tea bush ought to tend ; and failing in that, we miss the only rational road leading to success : and the proof of our having wandered far from that road which Jacobson long ago pointed out, lies in the fact of so many different modes of pruning having been at one time and another tried and all discarded in turn,—the latest always being thought better than that which it displaced. I have hitherto referred only indirectly to Jacobson's treaties on tea cultivation, but shall now do so directly, as it is the oldest we possess on the subject, and I shall afterwards refer to Colonel Money's, which is the newest, and by comparison try and ascertain if all or any of the systems of pruning that come in between the two, be really indicative of progress.

In the Handbook for the Manufacture and Cultivation of Tea in Java, it is said :—" The ordinary pruning scarcely deserves to be styled pruning : it is rather a cleaning, trimming, cleansing, and thinning out of the plants." The above is perhaps a pretty fair epitome of Dr. Jacobson's views on the subject of scientific pruning between 1837 and 1841. However, in some respects, his translator has probably failed to do him full justice,—no doubt unintentionally ; still, there are doubtless some shades of meaning in the original that he fails to convey to his English readers, and perhaps as markedly so on the subject of pruning as any other in the book.

Since the time Jacobson wrote, up to the present, the only other real contribution to the subject that I know of is a paper on tea pruning by Dr. King, which stands alone amongst the literature on the subject, alike distinguished by its lucidity, point, and scientific accuracy, and well merits the attention of those who would like to know a little more about the first principles of scientific pruning than can be learnt from any of the Prize Essays yet published. From the point when Jacobson left pruning, some 30 years ago, there has been progress in every

direction, save in a forward one. Had all the innovation and change since made, represented real progress, pruning to-day would have been something other than mere ignorant empiricism. Thirty years' experience has done much for some of the branches of horticulture, but for the one here spoken of, literally nothing.

The representatives of all the different systems yet tried may have been quite at one regarding the end to be attained, but by either overlooking or ignoring the teaching of science regarding the functions of stems, leaves, and roots, have gone far wide of the point they intended to reach. So that whatever their theoretical definition of the term pruning may have been, the practical one (in many cases at least) has come to be indiscriminate and systematic mutilation. The term pruning I shall in all cases use exactly in the same sense that Dr. Jacobson does, *viz.*, thinning out, and regulating of good leaf-bearing wood, the entire removal of that which is weak and twiggy or old, scrubby and unhealthy, also the foreshortening of moderately healthy wood which may have become a little scrubby at the top from plucking. The increased production of leaf is the end in view, and the removal of worthless or superfluous wood is the only plan by which that end can be attained. Dr. Jacobson's method of thinning and regulating is indeed the only one that will enable the tea planter to fully utilize the results to be gained by regular hoeing and manuring.

How we hoe, or how we manure, experiment has shown to be of little consequence if the bushes are suffered to remain choked up with scrub and worthless spray. In short, whatever is unsuited to the production of good leaf must be removed, no matter whether worn out through age and hard work, or weak and twiggy by overcrowding. In order to make a uniform well-finished tea, it is essentially necessary to have quickly grown, well-developed succulent leaves, and such can only be produced by healthy vigorous wood, with a full exposure to air and light. As wood becomes old and hard, the sap tubes become partially or wholly filled up by a deposit that lessens their sap-carrying capacity, and renders the walls more or less impervious to the ingress and egress of the up-going sap current, diminishing its volume and retarding its speed: thus a sluggish development, and thin, tough, leathery leaves, are the immediate consequence. Also through continuous plucking the branches become sub-divided into such a number of branchlets that the sap-carrying capacity of the stem is wholly insufficient for the wants of the spray and scrub that accumulate at its top. Many of these branchlets produce leaves so minute that they cannot be plucked, and even much of the leaf produced by the more robust of them is so thin and tough that it will make only low class tea. By way of further illustrating the great importance of a periodical removal of old worn-out wood, there is yet another ill effect of constant plucking that requires notice, *viz.*, it prevents wholly (or nearly so) the promotion of new layers of wood, as the whole of the material prepared by the leaves for that purpose is removed with them when plucked, and goes to make tea. So that in every working branch in the bush, from the date on which the first leaf is taken off it, until the close of its career, there is a steady process of deterioration going on,—a steady diminution in the quantity of new wood formed, a steady silting up, so to speak, of the sap-carrying tubes of the old wood, and a steady

increase, a geometrical one, of scrub and spray at its top. Nor is such a circumstance to be wondered at, as a striking analogy presents itself in the animal kingdom—amongst the high members of it at least. I have been told that, with the increase of age, the walls of the arteries lose their elasticity and flexibility, in a great measure owing to a process of degeneration taking place in the character of the tissues of which they are composed. The walls become thickened, and more or less cartilaginous in character,—quite the counterpart of the thickening of the walls of the sap tubes: hence a diminished and sluggish flow of sap in the one case, and the same with the blood in the other. So hence the stupidity and inutility of these systems of pruning which treat all the branches of the tea bush alike in giving the whole a uniform crop over. Whenever bushes, pretty well worn with age and hard work, get pruned in the generally approved fashion, a considerable portion of the old gnarled wood so operated on never breaks at all, or if it does, the shoots produced are equally worthless with the worn-out scrub removed. Of these gnarled branches that have their tops so taken off, a good many break into leaf some way down, and a greater number break from the very base of the branch, the dead scrub forming a protection to the young shoots until they fairly overtop it,—one of Nature's lessons to those capable of reading it: pointing out the necessity for a more rational system of pruning, and also showing the inutility of any attempt to improve by merely cutting back wood that has become deteriorated, both in structure and function—in short, fairly worn out with hard work. I have heard the remark:—

"If there be a constant process of deterioration from thickening of the cell walls by a deposit of matter, partly organic and partly inorganic, going on in every working branch throughout the entire period of its life, the mere act of cutting out such branches can prove no really efficient means of renovating the plant; for, by any mode of cutting possible, there must always be a portion of the base of the worn-out branch left, and equally worthless with the part removed; and as it is generally from the bases of the removed branches (at least oftener than from the collar) that the new shoots arise, this section of the old branch must act as a stricture against a free flow of sap between the root and the new shoots, if the removal of old wood, in combination with good cultivation, be the only efficient means we possess for the renovation of old bushes."

The foregoing it would be safer to evade than attempt answering. However, there are one or two facts connected with circulation, which, if they cannot altogether explain away these objections, may to some extent modify them. First, it is a fact well known that from evaporation by the leaves the sap is much denser at the apex of the stem than at its base; so, hence, a greater as well as denser deposit on the walls of the sap tubes towards the apex of the stem than at its base. Next, under natural conditions the demand for, and the supply of, food is always pretty equally balanced: in other words, the capacity for the absorption of food is always equal to the capacities for the digestion and assimilation of it. But as the tea bush lives under altogether artificial conditions, the capacity for the absorption of food must always be in excess of the capacity for digestion and assimilation. As it is the leaves only that perform these functions, the continuous removal of a

large portion of them must seriously affect the circulatory and digestive systems, and affect them first towards the apices of the branches, thus intensifying the character of the deposit just spoken of. Such at least seems probable from the fact that the sap attains its maximum of concentration and density there, and from the fact previously noticed, that old wood, when topped, either breaks some way down or from the bases, showing that the base of an old branch has a great deal more vitality and vigour than the top has.

Connected with the foregoing, there is yet another fact of importance, *viz.*, that at no period of the year, even amongst deciduous trees, are roots ever wholly inactive; and the sap pumped up towards the fall of the leaf, forms a starchy deposit, which is re-dissolved by the sap current of the ensuing spring, and with it undergoes digestion and assimilation in the usual manner. So in the case of the tea bush; an old branch after pruning, in one respect at least, resembles the deciduous tree in being destitute of leaves, but unlike it in having no young wood; so that in a plant having abundance of young wood, even supposing it has no leaves, the functions of respiration and digestion are never wholly suspended, as the functions of young bark are to some extent the same as those of leaves, and that may be the reason why young wood when cut back breaks so much more quickly than old wood. Hence, in the case of small gnarled oldish wood with a more or less corky bark, whenever the leaves are wholly removed, circulation must come to a dead standstill, as bark in the corky state can do nothing to assist circulation. Such being the case, there is nothing to excite surprise when partial death follows the cutting of wood such as is here spoken of. Vegetable, like animal tissues, in the gradations between youth and old age, are no doubt endowed with different degrees of vitality; hence an arrested or enfeebled circulation in either case leads exactly to the same result, *viz.*, the death of the extremities; but with our limited knowledge, the only legitimate and plausible conclusion seems to be that this effort at breaking half way down or from the base is one of Nature's modes of readjusting that balance between the absorption of nutriment, its digestion and assimilation, which the art of the planter has deranged or destroyed. It is hardly necessary to remark that bushes with a considerable amount of gnarled, sickly, scrub and weak useless spray, suffer far more severely, both from drought and insects, than moderately healthy bushes do; an unheathy top is always indictive of an unhealthy root, and whenever drought is prolonged and a little severe, such bushes not only cease to produce leaf, but assume a miserable burnt-up like appearance,—while the drought lasts look as if they had been scorched by fire, and even for some time after a good fall of rain look, if possible, more miserable than before from the pale sickly yellow they assume. Of course, for all that the sun may be to blame, or the soil may be to blame, but vicious plucking and irrational (pruning most likely the true causes) are never spoken of, or even suspected.

Every tea bush, like every animal and every machine, is, under certain conditions, capable of performing a certain amount of work during its term of existence. A horse may occasionally be made to do in one day an amount of work that it might be judicious to allow two for, did circumstances permit; and were that continued for any length of

time, no one would feel surprised at, nor indeed expect anything else, than a complete break down. I suppose it is also a fact that a cart or railway carriage axle is under ordinary conditions only capable of going a certain number of miles, with a certain load and at a certain speed. But, unlike other things, there is no assignable limit to the amount of work the tea bush is supposed capable to performing. Neither hard work nor abuse are supposed to affect its general health, or injure its leaf-producing capability in any way: so a very recent writer tells us. However, the annual plucking and the annual mutilation it is afterwards subjected to, might be supposed to affect its general health in some degree. No doubt, any alteration for the better in the treatment of the tea bush will affect it favourably, just as in other things: improve its present condition, and that will ultimately improve its productive capabilities. Still these capabilities are limited, and will ever be so from the very fact that every leaf taken off the bush affects the nutritive system. Unlimited capability for the production of leaf implies a capability as well as favourable conditions for unlimited development of the nutritive system, *i.e.*, roots, stems, branches, and leaves; but plucking and pruning rigidly limits the development of these to very moderate dimensions. In the general treatment of the tea bush the fact that root and leaf action are reciprocal has been far too frequently either overlooked or entirely ignored. Without a vigorous development of roots, there can be no vigorous development of leaves; and without a vigorous development of leaves, there can be no vigorous development of buds and young wood, nor yet of new layers of wood on existing stems; and without a free development of new woody layers, there can be neither a free nor a vigorous circulation of sap. And here we return to the point from which we set out; without a vigorous circulation of sap, there can be no well-developed leaves, nor yet healthy roots. Physiology teaches that all vital action is reciprocal; every function, healthy or unhealthy, is interdependent with some other; and experience is every day confirming the truth of the doctrine, alike in the cultivation of timber, fruit, vegetables, or leaves for black tea: so that the question we here stand face to face with, though apparently similar to a prominent one in Animal Mechanics, (*viz.*, that a certain amount of work performed, implies a corresponding deterioration of muscle), still the similarity of the two is apparent only. In the case of the animal, food and rest will soon restore matters to their normal condition, but in the case of the tea plant, where a certain amount of work represents a certain amount of destruction of the organs of digestion and respiration (a matter not so easily readjusted, and thoroughly antagonistic to the theory of "no limit to productiveness)," a marked tendency on the part of the tea plant, or any plant whatever, to the excessive production of flowers and seed, is a sure sign of old age, or weakness from some cause or other, and in the case of the tea bush without doubt induced by the repeated removal, year after year, of a considerable portion of the organs of respiration and digestion; and if the plant be only moderately old, a clear intimation that in plucking we have far exceeded that limit at which a moderately fair state of health is possible, and at which common sense, had it been listened to, as well as physiological science, would have

said—Stop. No doubt, under any system of plucking possible, prune and manure as we may, there must come a time when the bushes will cease to produce leaves, as neither species nor individuals are everlasting; and accepting that fact as inevitable, the question for immediate consideration is, do any of the present systems of vicious plucking and unscientific mutilation give better or larger returns than can be got by that old-fashioned conservative one of Jacobson's? Under which of these conditions, judicious thinning and foreshortening, or wholesale mutilation, will the tea bush last longest and retain most vigor for practical purposes? To these questions, or others of a similar kind, no definite reply in the form of statistics extending over a number of years is at present possible. However, the teachings of Vegetable Physiology makes this much at least certain, that whatever the duration of life and the degree of vigour retained in the one case, under like conditions as regards soil and exposure, they must be greater in the other. That is no mere hypothesis but an undisputable fact, and one that has received ample illustration in the annals of scientific horticulture.

There seems little or no difference of opinion amongst planters regarding the season of the year at which pruning ought to be done. The period during which the bushes are at rest is invariably recommended as the time at which it can be best done; and one advantage of Dr. Jacobson's plan is, that it can be successfully practised at any season of the year whenever there is time or men to spare; no danger of either checking or seriously injuring a flush in any way; as the operator deals entirely with worthless non-productive wood, and so far as I can understand him, Jacobson attaches far less importance to the time than the manner in which pruning is done. He does not assert that it is unimportant at what time shortening back is done; the time generally recommended for pruning is perhaps the best for that operation, but shortening back is often done without thinning, so thinning can be equally well done without shortening back, and be done with as great benefit to the tea bush during the months of May and June, as during December or January. It might perhaps be an advantage if means would always admit of the whole of the pruning being done by February, but in most cases that would necessitate an extra establishment,—a luxury neither always attainable, nor yet desirable, on ordinary plantations.

Having already said so much regarding the method of pruning recommended by one of the oldest writers on tea, it may not now be amiss to hear what the most recent writer on the subject has to say. And as Colonel Money writes some thirty years later than Jacobson, it may be supposed his opinions on pruning must (at least ought to) be in advance of Jacobson's or of any other writer on the subject. Such indeed is Colonel Money's own opinion, for in the Preface to his Essay he tells us :—"I have now *tested all* and *everything* connected with the cultivation and manufacture of tea by my own experience." After that it surely becomes us, who know comparatively little, to listen with reverence and attention. He says : "There have been many theories about pruning tea bushes, but none, I think, worth much, practically, for the simple reason that it is impossible to prune with the care and system a gardener prunes a favourite fruit tree. The operation must be a coarse one, done by ignorant men in large num-

bers, at one time, who can in a measure be more or less taught; and the nearer they do right the better; still, really careful and scientific pruning can never be carried out on a tea plantation. I shall confine myself therefore to giving such directions as may be practically useful." I shall now try and show what amount of scientific knowledge lies behind this Preface.

Pruning a tea bush is a rather simpler operation than the pruning of a "favourite fruit tree;" and even supposing the skill and intelligence competent for such a task available, it would never pay to use it so on the tea bush. In pruning a fruit tree, whether wall or standard, no small amount of the intelligence, tact, and taste employed, are expended for no better result than mere appearance; sometimes a little side grafting or inarching to do, or if the subject be a young one, for sake of appearances it must be kept for some time in hoops, a species of crinolining; and to do all that properly it requires taste and time, no less than scientific knowledge. But mere appearance for the tea bush is a matter of only second-rate importance, productiveness being the chief end to be kept in view. Although the operation of pruning "must be a coarse one done by ignorant men," still on the generality of respectably-managed plantations, there are always a considerable number fairly competent for such work after a very little instruction. And the style and spirit in which such men do their work after a little training, shows no want of either apprehension or intelligence on their part. A learned disquisition on the microscopic structure of roots, stems, and leaves, bisplasm, &c., &c., certainly might puzzle and bewilder most of them; but for any thing such there is no necessity. Dr. Jacobson's theory of pruning, thinning, regulating, and removing scrub and spray, they can easily be made to understand, and they give ample proof that it is intelligible to them, by the character of their work. But as the teacher, so will the pupils be; should he be a little muddle-headed or old-wifish in his ideas, he must expect them to be the same. However much our author may disparage all theories of pruning, he evidently feels that he cannot do without one: "And it is correct, in pruning, to cut near above a bud or branch, but not near enough to injure them. The cut should be quite clean and sloping upwards, so that nothing can lodge on it." But that is not a theory of pruning, only a theory of cutting, and only partially correct. Better authorities than Colonel Money say, the cut ought to slope face downwards, not upwards, so as to prevent the action of sun and rain on its surface as far as possible. But cutting is one thing and scientific pruning quite another. The generality of butchers are splendid cutters; still, in the case of taking off a leg, or removing a stone, there are probably few who would on that ground prefer the services of the knight of the striped apron and steel, to those of an intelligent yet cautious surgeon. The question of how to cut, I by no means disparage; but the question what to cut, is immensely more important. The theory of pruning says that wood of such and such a description ought to be cut out for such and such reasons; while the theory of cutting merely says that if such and such is to be removed, it ought to be done in such and such a manner. A man may be able to cut correctly, and yet, at best make only a hash in the matter of pruning. But the foregoing are only a part of Colonel Money's directions in pruning. He

says: "The best plan is, I think, to have two gangs. The first to go ahead and cut out the thick wood (here judgment is necessary, so let them be the best men) to varying heights from about 12 to 18 inches. The second gang to follow, each with a rod, 20 inches long, to cut down all the light wood left to that level." Certainly, rather a neat theory and in point of perspicuity simply perfection. It contains nothing that will in the slightest puzzle a beginner, even supposing he has never previously seen a tea bush. He has only to read over these practically useful directions, and in an instant be transformed into an accomplished pruner. Worn-out wood, twigs, and scrub may be phenomena entirely unknown in Chittagong; and if so, these directions may be really useful there. But wherever else such evils may abound, they are not only useless but worse than useless, as the very evils it was meant to cure will thereby be intensely aggravated. Colonel Money somewhat complacently remarks that really scientific pruning is impossible on a tea plantation, and certainly no one who reads and has an intelligent understanding of the tendency of his directions will entertain a doubt about the truth of the assertion,—at least on plantations where these directions are strictly adhered to.

I shall now discuss a little in detail the scope and tendency of Colonel Money's directions, and see how far they agree or disagree with the dicta of modern physiology. "The Indigenous grows quicker after the second or third year than the China, if it has not been overpruned or overplucked when young." Again: "It is difficult to prune the China plants too young; on the contrary, the Indigenous requires tender treatment in this respect."

The meaning of the last sentence, as it stands, is to me unintelligible. Why is it difficult to prune the China plants too young? Or what is this particular "respect" in which the Indigenous requires tender treatment? The sentence last quoted occurs in the chapter on "The Varieties of the Tea Plant;" but why it should have occurred there, or what it means there, there is nothing that affords any explanation. Again: "Of two extremes, at least with the tea plant, it is probably better to overprune than to underprune." In comparing the last extracts with the one immediately preceding, it will be seen that Colonel Money proves, to his own satisfaction at least, that the treatment injurious to the young tea bush, is the most appropriate for the old one; *i.e.*, severe pruning is bad for young plants, but good for old ones. Perhaps, he merely meant to surprise his readers, (beginners,) with a paradox; however, in the entire absence of anything like a key, ordinary people can only consider it as a contradiction. Beginners are also instructed to "prune so as to cause lateral growth," also, "that plants ought to be more or less pruned out in the centre." Which of these two systems does our author really mean to recommend? Or are they of equal importance? Any one at all acquainted with pruning, in the ordinary sense of the term, perfectly well knows that two such diverse modes cannot both be practised at the same time on the same bush.

Colonel Money speaks of the care and system with which a gardener prunes a favourite fruit tree, but does not seem to be aware that no inconsiderable part of his art consists in the care and forethought shown in distributing the young wood and fruit over the whole tree, in as equable a manner as possible, so as

to have no overcrowding, and to have every shoot and fruit receive a fair amount of air and light; and that result cannot be attained by either pruning out the centres, or pruning so as to cause lateral growth, but only by Dr. Jacobson's plan of thinning and regulating.

The reason assigned for pruning out the centres of the bushes, like some others that he offers beginners, is rather a peculiar one: "In the following spring, young wood is then formed in the heart of the tree, and it is only young wood and shoots that give leaf." Is there, I wonder, any structural or functional difference between shoots and young wood? By what characteristics are they to be distinguished from each other? Does the one bear superior leaves to the other? However, whether different or not, we are informed that both give leaf, and therefore crowding them together in the centre of the bush must be beneficial. In the Class-book of Botany, Professor Balfour says: "In cases of overcrowding, where the branches are not allowed freedom of growth and exposure, the leaf-buds are consequently either arrested or feebly developed." To a certain extent it is true that the more a tea bush is pruned and plucked, the more it will yield. It appears as if Nature were always trying to repair the violence done to the tree by giving it new mouths or leaves to breathe, with in place of those taken away.

And again: "If leaves, are prevented from performing their functions properly by being kept in darkness or in shade, wood is imperfectly formed; and if the leaves are constantly *stripped* off a tree, no, *additions* are made to its woody layers."—*Class Book of Botany.* Thus it seems that whenever leaves are frequently removed, we take with them almost the whole of the material elaborated for the promotion of new wood, &c., and thus prevent, to a greater or less extent, the promotion of new shoots and new leaves. If the material required for the promotion of new wood, bark, &c., could be prepared and deposited in the entire absence of leaves, such an arrangement, on the part of Nature, would be a most unsuitable one for the tea planter, as the returns of tea would be considerably smaller than under existing arrangements. Surely this is a most convincing proof to the sceptical in such matters that the tea plant was created with the special view of producing leaves for the purpose of being converted into tea. If Colonel Money be right, the whole school of modern physiologists are all wrong; however, as he has "tested all and every thing connected with tea cultivation by his own experience," it is just possible he may be right. Still, men of science, not mere empirics, tell us, in language too plain to be mistaken, that under normal conditions, throughout the whole life of the plant, new leaves demand new roots, and new roots new shoots and leaves, —leaf and root action being reciprocal: always pretty nearly balanced, yet never reaching that point at which no more of either are required. Plucking is destructive of this balance maintained by Nature, under ordinary conditions, between roots and leaves, and the effort to restore the balance thus destroyed by plucking is manifested by an effort to produce new shoots (in ordinary phrase—flushing). Another removal or destruction of these shoots by plucking results in another attempt at flushing; and so on to the end. Colonel Money is at some pains to assure his readers that "*flushing* is *growing*," and that "when a plant is not pruned and plucked, it gives up

flushing" (gives up growing) and *yet grows* gradually large and bushy. Modern physiologists seem to hold the opinion that the root of the plant is the true analogue of the mouth of the animal, as plants do not, like the higher orders of animals, breathe through their mouths. Leaves are generally believed to perform functions analogous to respiration and digestion in animals. "The fluids which reach the cells and vessels of leaves undergo changes by which they are elaborated and fitted for the formation of the various vegetable secretion."—*Class Book of Botany*. And again: "The main use of the foliage is to expose the crude juice to the action of the sun and light, and to elaborate them for the use of the growing plant." The leaf is thus at once the stomach and lungs of the plant.—(See *Manual of Botany*, Dr. R. Rrowne). In addition to that compound function just stated, leaves seem to have yet another: Whatever matter the roots take up in excess of what is required for the formation of the various tissues and compounds secreted by the plant, is left as a deposit in the cells of the leaves. Thus leaves contain a greater amount of inorganic matter than an equal weight of wood does, and old leaves contain more than young ones: may not therefore this deposit of inorganic matter in the cells be the direct cause of that coarse, earthy flavour always characteristic of a low-class coarse tea, rather than a change in the elementary tissues of the leaf. No doubt, a hardening of the tissues may be synchronous with this deposit.

(II.)—*Plucking.*

It has been already remarked that continuous plucking produces scrub at a rapid rate—an evil no doubt, but an inevitable one, which must be accepted and dealt with in a manner as little injurious to the health or the plant as possible. However, Colonel Money does not seem to think it so, and rather seems to rejoice in the tremendous increase, and blames the soil for its incapacity or want of power to fling out new shoots; seeming to forget that whatever interferes with that balance established by Nature between the absorption of nutriment, its digestion and assimilation, must impair health and abate vigour; and the cumulative effects of the treatment he recommends are well calculated to do both. He also seems to forget that, in carrying on the circulation, there is mechanical and chemical, as well as vital, energy at work—not isolated, of course, but in combination and interdependence. By transpiration the leaves remove the watery parts of the sap; hence, as it ascends, its specific gravity increases: and everyone knows that fluids of different densities, when brought in contact with each other, are separated only by a permeable membrane, have a marked tendency to comingle until both become of uniform density; and hence the principles of endosmose, exosmose, and capillary attraction work together with vital force, in carrying on the circulation; and, as the leaves are constantly at work, removing water, and so rendering these portions of the sap in closest proximity to them denser than that a little lower down, so with this diminution in volume from transpiration, there is at the same time a transference of the digested sap to the *descending* system—there to be assimilated in the development of new layers of wood, leaves, buds, &c. Hand in hand with these processes, there is a steady upward current

compensating for the loss in volume caused by evaporation, and for the transference of the digested sap to a different system: so a large leaf surface implies a rapid and vigorous circulation, and to whatever extent we diminish that, to a corresponding extent we diminish vigour and rapidity of growth.

Colonel Money's chapters on pruning and plucking, if they can be said to prove anything, prove that wholesale mutilation of the nutritive system of the unfortunate tea bush is absolutely essential to vigorous health and unlimited productiveness.

It has happened *oftener* than once in the history of tea cultivation (and will do so again) that some ignorant pretender has become manager of a garden in a fair state of health and vigour, and after a few years of vicious hashing and vicious plucking has had to hand over his charge to some other to make of it what he best could. A moderately-healthy garden will bear up under a radically vicious course of treatment for several years, without showing any perceptible decrease in the total outturn, or much falling-off in the percentage of fine teas. But when the necessity arises (and in time it must) for remedying such a state of things, the man who takes the matter in hand must work for several years at an increased yearly expenditure, without being able to show any increase in his outturn, or much improvement in the percentage of first-class teas. A plantation may be *run down*, partially ruined without any increase of expenditure,—nay, even show a reduced one, with, at the same time, good outturns; but when once run down, and then an attempt at improvement, a *decrease* in the outturn and an increase in *expenditure* are absolutely unavoidable, as the ill *effects* of vicious treatment do not cease with it, but run their inevitable course, which it may require years to arrest and remedy.

In the matter of tea cultivation, Government has neither done all it ought to or could have done. Where it has so conspicuously failed is in the fact that experimental cultivation was all but entirely lost sight of in the desire to spread the tea industry as fast, and as widely as possible by distributing seeds and plants throughout the country. It was no doubt pointed out by the superintendent many years ago that the production of tea, and the production of tea seed, were entirely different objects, and to be obtained by altogether different means, *i.e.*, high cultivation with the view of getting large outturns of tea was incompatible with growing large quantities of seed for distribution, as both could not be done at the same time. Hence the "Kampani Bahadur," with clearly defined visions of a glorious future for its children, increased imports. Government has thus done no more than just half what it ought to have done; and that half left undone, not by any means the least important part of the experiment. It may be said that private enterprise, if left alone, is perfectly competent to work out satisfactory replies to any questions that may arise connected with tea cultivation, and it would be well were it so; but that has been neglected in the past, and to all appearance will be for a long time to come. Further, overseers and managers are a little nomadic in their habits; and in changing to a new place, a man has seldom the means of availing himself of any part of his predecessor's experience, even supposing him willing to profit by it, which is not always the case. The rule, indeed, generally seems to be, to undo as far as possible what-

ever his predecessor in office may have done; and, often, without any better reason than mere caprice. One man may feel dissatisfied with existing opinion and practice in some particular branch of cultivation, and make up his mind to experiment a little in hopes of finding something better; but before even tentative results can be had, he may have to make way for some one else who sees no necessity whatever for experiment in that particular direction, nor probably in any other. So hence the necessity for Government taking up the question and working out in detail, with care and judgment, such a series of results as will raise the art of tea cultivation out of the slough of ignorant empiricism, and place it in a position compatible with progress and improvement. Not only are we in the dark on some questions only, but on many upon which we profess to have real knowledge regarding.

When asked for sound reasons for our opinions, these reasons often amount to no more than mere presumptions or suppositions. For example, to such questions as the following, what would be the intrinsic value of any replies forthcoming: What is the difference in the returns given by bushes hard plucked, compared with bushes moderately plucked —extended say over a period of ten years? And what the state of health and vigour of each set of bushes so treated at the end of that time? What is the difference in the results given by bushes pruned in the various modes enumerated at the beginning of this article? And how would the health and productiveness of a set of bushes be affected by any particular mode of pruning over a period of ten years? What is the difference in the returns given by bushes receiving manure every year, every second year, every third year, and every fourth year, compared with bushes receiving no manure? Or when manure is given at intervals of two or three years, ought it to be given previous to or after a severe thinning? Or when manure is given, whether are the immediate or remote results the most marked? *i.e.*, are the first year's results better than those of the second or are those of the second year better than those of the first? What is the return got from wide planting, compared with close planting over a period of ten years? Or are the remote advantages of close planting as great as the immediate ones? Replies to all, or to any of these questions, and many others of a similar kind that will from time to time crop up, to be of any value whatever, must show the pecuniary advantages of one plan of working compared with some other. On such questions a mere guess, a supposition, or an assertion from any authority whatever, no matter how respectable, must simply be taken as such. Some of them have already been handled, but with little result, and simply because there are no reliable data in existence for a satisfactory solution. And until definite replies can be given to some of the foregoing questions, and some others that will arise out of them, any real improvement in the art of tea cultivation, if not absolutely impossible, is highly improbable.

The results from such a series of experiments as those indicated, if wrought out with care, would not only definitely settle many doubtful questions, but would make further improvement and progress comparatively easy. The literature of tea, then, instead of being, as it now is, a series of dreary trivialities and silly commonplaces on subjects of only second-rate importance, should have a series of special articles by competent writers on really impor-

tant subjects—the immediate result of careful experiment and accurate observation, regulated and controlled by the principles of physiological and chemical science. Then, and not till then, will we have entered on an era of progress. Government introduced, and for a time encouraged, tea; but it still remains for it to show those who have embarked capital in that branch of industry, the one out of the many modes of cultivation now practised which will give the best returns,—in short, show which will pay best.

A few Remarks on Pruning Tea.

Although it is about a quarter of a century since the cultivation of tea begun in India, only a few years, so to speak, have elapsed since tea first began to be seriously looked upon as a garden crop, and to have the commonest principles of horticulture practically applied to it. The idea that formerly for years guided tea planters, appears to have been that tea was a kind of forest crop on which high cultivation would be thrown away. Hoeing and manuring were likely chiefly to stimulate the growth of rank grass and weeds that still disputed possession of the soil (usually only too successfully), with the Chinese exotic, to the success of which they were looking for the realizations of their fortunes. In consequence of their attachment to such ideas, they did not consider a practical acquaintance with farming and gardening as of prime importance in the management of a plantation. Great energy, no doubt, was often displayed in planting out tea bushes, but none whatever in caring for them afterwards. Nothing was done to encourage the development of the bush whereby the yield was to be obtained; the practice was, thankfully, to collect what leaves the bushes might yield, and by the aid of a Chinaman (who might or might not have had anything to do with tea-making in his native country) to convert the latter into as good tea as possible. Among the ordinary operations of gardening in respect of which tea had been, until a few years ago, quite neglected, is that of pruning. Many will say that pruning was practised all along, and to the then simple mind of the planter no doubt it was. A barbarous mode, I believe, was in practice, *i.e.*, going over the bushes with a pair of shears—the manager, baboo, or whoever he was, giving each coolie a stick; this he was instructed to place in the centre of the bush, and to cut it off to the same height. This, of course, bruised the ends of the young shoots to such a degree that they, in most cases, died for two or three inches below the place they were cut at, and in many instances destroyed the plants altogether. The planter of Assam during this benighted period was still more in the dark as regards the science of pruning; *his* mode of operation was to arm each coolie with a huge knife and a block of wood, and instruct him to gather the branches into one hand, bend them over on the block, while with the other he severed a foot or so from off the top of the bush, with as scientific a flourish as possible. This was called pruning; however, I am glad to know that these doings are of the past, and on the *rationale* and practice of pruning I would now venture to submit a few remarks.

In many gardens in '70, '71, and even in '76, you could see pruning carried out with the knife much worse than during the shear period. I have seen a garden, where the bushes were on an average four feet high and two feet in diameter, operated upon in a manner that would have made any man mad, who had had even the slightest idea of what the bush required to develop it into a good leaf-producing plant.

A few remarks, therefore, upon the facts and principles on which the oper-

ation is founded might be of use as guiding to a correct practice; and, before going further, it will be necessary to consider briefly the structure of the stems and leaves of plants, and their mode of nourishment and growth.

The organs of flowering plants may be divided into vegetative and reproductive. The vegetative organs are those by which the life of plants are sustained, and by means of which they grow. They consist of root, stem, and leaves. The reproductive organs (consisting of flower, fruit, and seed) are concerned with the continuation of the species by the production of other varieties, and they are supported by this plant for this purpose. It is with the former set that we are now chiefly engaged; the structure of each and all of these parts (however much they may differ from each other in texture and external appearance) is fundamentally the same. Each consists of an agglomeration of vegetable cells. The vegetable cell, which is thus the ultimate elements of vegetable anatomy, consists typically of a very minute spherical closed sac, with certain fluid and occasionally solid contents. It is in fact a tiny bladder filled with fluids and solids, the membrane being thin enough to allow the passage of fluid through it; but although typically spherical in form, cells are rarely so in fact. Some are developed into ducts and cylinders of various sorts, for the transmission of fluids in the stem and leaves; others are lengthened out into spindle-shaped bodies, and made up into small faggots for the formation of wood: many are flattened brick-like forms for the construction of bark and into tiles for smoothing off the surfaces of the leaves, while an immense number are used as packing material or padding, and are stuffed wherever there is a blank to be filled up in the internal structure of leaves. The pith of young plants is also made up chiefly of cells squeezed into a variety of shapes by pressure; but modified as they may be in form and function, they all remain essentially cells, and while young, the walls of all have the property of giving passage to fluids and gases. The cells in old wood, however, are exceptions, as their walls having become thickened, and their cavities obliterated, they are nearly, if not entirely, impermeable by fluids. If the stem or branch of a tea plant be cut across and examined with the naked eye, the following parts will present themselves:—In the middle of the stem, if it be an old one, there will be seen a cylinder of hard wood; outside this a circle of green young sap-wood, and encircling all, the layer of bark. When examined microscopically, the central cylinder of wood is found to be formed chiefly of spindle-shaped cells laid close together vertically, and with these tapering ends overlapping. In old wood, as has just been said, these have become incapable of transmitting fluid and, therefore, of performing any vital function, and the wood formed of them is useful to the plant merely as a mechanical support. This explains how trees that have become hollow from the decay of the wood in the centres of their stems can continue, nevertheless, to throw out leaves and to yield flowers and fruit. The structure of the encircling layer of young or sap-wood differs in no way from that of the hard wood, except that the walls of the spindle-shaped cells, of which it mainly is composed, are thin and pervious to fluids, and the cavities of the cells are themselves filled with fluid.

In stems of plants that have not attained a sufficient age, no central cylinder of hard wood will be recognizable. The whole of the woody tissue will, in such stems, be found to consist of sap-wood, which will, however, be of greater density towards the centre. When the sap-wood is cut across, a greater or less amount of fluid will, at certain seasons, exude; and this is the layer which, in the language of gardeners, "bleeds" if cut while the sap is rising. Outside the ring of sap-wood is the bark which is composed of several layers, the inner of them being vascular and

affording passage to fluids, the centre mainly protective.

The woody parts of the root of a tea plant being in reality merely stems situated under ground, will be found to resemble the stem proper in structure. The real roods consist not of the woody parts which give mere mechanical support, but of tender fibrils which proceed from these. These fibrils are composed of cellular tissue permeable to fluids; and, as will be seen presently, they are the chief means by which a plant collects its food.

The leaf which is anatomically but a flattened expansion of the branch, and which retains an organic connection with it, consists of a mass of loosely-packed cells confined between two cellular membranes (which form the skin on its upper and lower surfaces) and penetrated spreading bundles of fibres and vessels—the so-called "veins"—derived from the branch. These loosely packed cells, as well as the vessels of the leaf, are freely permeable by fluids. The root, stem, and leaves, of which the above is a rough account, form the organs of a plant's digestion and assimilation, and, therefore, of its growth. The material of its food must now be considered, also the mode in which these materials are taken up and digested.

Plants cannot take in solid food. Whatever they absorb must be offered to them either as a fluid or a gas. The gaseous food of plants, in as far as it is absorbed in the state of gas, may be omitted from particular consideration at present. It is in the form of fluid that the great bulk of their food is taken up. This fluid consists of the natural moisture of the soil, the various salts of the earth, and of manure which that moisture may hold in solution, and is absorbed by the delicate root-fibrils which radicate in all directions in search of it.

Collected from the soil by the fibrils, this undigested fluid is conducted to the stem, where, avoiding the hard heart wood, it passes into the part described above as the young or sap-wood layer; and, transmitted from cell to cell, passes upwards through the main stem along this layer, enters the corresponding layer in the branches, and finally reaches the flattened expansions of these we call the leaves. This ascending undigested fluid is known as the crude sap. Having reached the leaves, and there becoming exposed to the influence of light and heat, this sap parts with a large amount of water by evaporation, and undergoes certain chemical changes. Thus altered in character (and as it were digested) by the processes to which it has been submitted in the leaves, &c., the sap is now no longer crude, but has passed into the condition in which it can be directly assimilated as nourishment by the cells of the plant. Up to this point the sap had been transmitted upwards in obedience to certain physical laws; and, during the upward passage, probably no nutritive functions had been fulfilled by it. Before parting with the fluid which they have thus elaborated, the leaves retain as much of it as they require for their own nourishment and growth, and the remainder they return to the branches and stem mainly through the vascular tissues of the inner bark, *i.e.*, the ring immediately outside the cambium. Passing downwards through these vessels as its main channel, the elaborated sap is distributed into all growing parts of the branches, stem, and roots, and in fact affords to these, as to the leaves, the material of their nourishment and growth. It is thus clear that the leaves are organs of very great importance in the economy of a plant's life; and, indeed, in the mutual interaction of these and of the roots its life may be said to consist. The truth of this is illustrated in the structure of the seed, which in the class of plants to which tea belongs contains the rudiments of two leaves and a root, with sometimes a little store of nourishment in addition. The parent plant supplies these to its offspring to enable it to start in life; and the very first thing the offspring does, when,

in the act of germination, it begins life on its own account, is to send the two embryonic leaves upwards, and embryonic root downwards, and so begin the mutual process abovementioned, thus becomes a living thing.

The evaporation which takes place in the leaves, consequent on the exposure to the air of the crude sap in them, is a potent cause * of the ascent of that sap in the stem, and of its collection by the roots. As long as the leaves remain green and healthy, and continue exposed to air and light, so long will the roots go on collecting from the soil, fluid which the young wood of the stem will transmit upwards in a steady stream.

The vigour of the one process is accurately proportioned to that of the other. The roots will not long collect, neither will the young wood of the stem transmit fluid, for which there is no demand for in the leaves above. If from any cause the demand made by the leaves should be suddenly reduced (as it would be by the removal of branches in pruning), the supply of sap, which had been collected to meet the previous demand, would thus become excessive, and excess would be got rid of either by the discharge known to gardeners as "bleeding," or by the plant making an effort to utilize it by rapidly putting forth new shoots and branches. Suppose, for instance, that a tree in full health and vigour be cut down close to the ground, either of two things may happen—the sap in course of collection by the roots will either simply run to waste on the surface of the cut stem, or a growth of young shoots will spring up round the margin of the stump, or from the underground stem. Shoots originating in this way are known in gardening as suckers; and the vigour and rapidity of growth shown by many of them, though often surprising, is easily explained when we consider that they are nourished by a root system calculated for the leaf system of a tree.

If shoots arising in this way be persistently cut down as fast as they appear, and the root system be thus deprived of all demand for its collections, and as it were of all object in life, it will soon decay and die. It is needless to say that, on the other hand, the growth and vigour of the leaves are modified by circumstances affecting the roots; and that any injury to the latter soon tells upon the former. Let us now consider for a little what systematic pruning and plucking of the tea-plant really amounts to; and what it is that the planter demands of the bushes in his garden? In the operation of the above, the plant is regularly deprived, during the season of active vegetative activity each year, of its young expanding leaves, and of the growing extremities of its branches. In other words, it is systematically deprived of the parts that are at once the organs of its digestion and the instruments of its growth, as fast as it provides itself with them.

Were the deprivation complete, the plant would simply die. But even in the most over-plucked gardens, it is only partial.

Not only, however, does the planter thus continuously deprive the plant to a serious extent of the very organs of its life and growth, but he demands that it shall continue for a series of years to be submitted to this process (plucking) and still continue healthy and vigorous; or, as he phrases it, to give good "flushes." Observe, too, the kind of leaves which have to be used for the manufacture of good tea. Are they old mature leaves, whose vital functions are sluggishly performed, and whose best days have past? The tea-plant being an evergreen, a large proportion of such might be removed without injury. It is not these, however, that are taken, but the young and growing, in which sap circulation is rapid and free, in which the vital processes are carried on with vigour, and to which the young branches bearing them,

* Dr. Hale's experiments on the ascent of sap.

and, indeed, the whole plant look chiefly for the materials of life.

Where the planter has asked the plant to yield up these for a succession of years, while he on his part, you may say, has rendered but small help in the way of manure and tillage, and improper pruning, it is not to be wondered at that tea-planting has in many cases proved but partially successful.

Now, if we think of the matter for a little, the process of "plucking" will be seen to be really of the nature of pruning; and to recommend pruning as a cure for the evils of "plucking," let us consider briefly the appearance presented by a young shoot of tea before the tip has been taken off by the plucker. Such shoot bears on its entire length, let us say, ten leaves, and at the point where each leaf springs from the stem, *i.e.*, at the axil there lies a small bud. Each of these buds is capable of development into a lateral branchlet. In a branch bearing, as we have supposed, ten leaves, it is not probable that, were things left to their natural course, each of the ten axillary buds would become developed into lateral branchlets.

When, however, the growing point of the shoot is removed, these axillary buds are stimulated by the ascending sap, and most of them expand into lateral branchlets, and these being in turn topped by the plucker, their axillary buds are stimulated, though in a less degree, into expansion and so on. The vigour with which lateral branchlets follow on "plucking," or topping the leaders, diminishes regularly with each repetition of the process, until after a year or season of this treatment a period of nearly complete stagnation is reached, and the original ten-leafed shoot with which we started presents the appearance of a tough, greyish barked stem, bearing at its top a dense collection of small, wiry twigs, which carry a quantity of small thin tough leaves totally unfitted for manufacture into tea. These twigs are of such low vitality that, when topped, they hardly throw out fresh lateral shoots or "flushes." The reason of this is simply that the small brush-like mass of shoots have increased in number out of proportion to their means of nourishment. The stem, through the sap-wood layer of which their nourishment is transmitted, has not increased proportionally with the number of the leaves which has been forced into existence by the operation of plucking; and it is a physical impossibility that, through the layer of sap-wood in the stem, there can be transmitted enough sap to support many young leaves in addition to the old ones with which its top is crowded. Were such a stem left to itself, and all plucking suspended for a time, it is probable that in some cases an equilibrium would be established between the leaves, and the sap-wood, and that the latter would again become extensive enough for the transmission of sap sufficient to support a natural succession of young leaves, or in other words "yield flushes," but the process of recovery would involve time, which to the tea-planter means money. A quicker way, therefore, of obtaining leaf must be tried, and this is found in pruning off the wiry spray and useless wood with which the bushes are more or less crowded, and cutting back to a proper height all strong growing shoots, so that the sap transmitted upwards may cease to be wasted in the support of leaves which can never be made into tea. These, as long as they remain on the plant, must have their needful supply of sap, and, further, that the sap may be directed into the new shoots which the plant may be expected to throw out after the pruning. It is thus that pruning becomes the necessary sequence of plucking, if healthy young leaves fit for tea-making are sought to be continuously produced. The end in view should never be lost sight of when using the knife, for the mere meaningless mutilation of a plant by its application is quite as likely to be hurtful as not. It is very difficult to get native workmen to understand the kind of stems and branches they are

to remove; and it will require much ingenuity and care, and incessant watchfulness on the part of a manager to keep them from doing harm. As is the case with many other matters it is easier to prune badly than to prune well: but there are few operations where the difference in results between bad and good work is more striking. In order to prune well, each bush ought (as has already been said) to be treated on its own merits; but as it is pretty nearly hopeless to think of getting native workmen who are capable of doing this, it would be necessary for the manager (after having clearly defined to himself what it is that he wants to effect, and the best way of doing it) to give his pruners a general idea of the kind of measures suitable for each portion of the garden, as they come to go over it, illustrating to them, practically, what kind of stems, shoots, and branches should be cut quite away, what kind should be merely trimmed, &c. It might be safely impressed on the pruners as a fundamental maxim *that old wood is to be cut away within a few inches from the root*, for it will generally be found that such wood bears no leaves of which good tea can be made, but merely the small thin sluggish sort that are carried by the broom-like masses of spray already described, as a rule; then the best thing that can be done with hard old stems is to cut them off low down, in the hope that fresh new shoots may spring from the root and take its place, or from the "collar," as gardeners phrase it.

By the removal of these, not only are a quantity of useless leaves prevented from preying on the sap, but light and air are secured for the young shoots that will spring up. If a bush be entirely composed of small twigs and spray, it is a question whether a certain number of them should not be spared until a succeeding year, to carry on as it were the life work of the plants, and not to trust entirely to the new start in life which a clean sweep of all would necessarily involve.

When we consider the influence that leaves have in promoting the collection and transmission upwards of the crude sap, it does appear more rational to leave a certain number of these old stems for one season, so that by their means sap may be attracted and elaborated for the benefit of the young root shoots which may be expected to appear as the successors of the stem that may be removed. Stems thus spared ought, however, to be cut away in the next year, by which time the young shoots will have acquired some size and will carry a number of leaves. If the mode be adopted of at once cutting down to the root the entire bush, the pruner, of course, accepts the chance of the roots sending up no young shoots at all, and, therefore, dying—a result which, for reasons above explained, is quite possible, and the possibility of which should always be borne in mind. Tea growing in unsuitable localities or in poor soil, and in tea which has been prematurely plucked, it is often the case that each stem is a plant, or a plant consisting of one stem; and to prune entirely away such a stem would, therefore, be to cut down the entire plant, which, as we have just seen, is to run the risk of killing it. A wise precaution in dealing with such weakly bushes would be, first to hoe deep and manure the soil round them so as to get them into a little better heart, then to prune gently, and finally to cut down by the root during the succeeding cold weather.

It is, of course, a question whether it would not be cheaper in dealing with such unhealthy tea to run all risks, and to cut it down to the ground at once.

The old hard stems of which we have been treating may easily be recognized by the appearance of their bark, which often lichen-grown and watery, is always grey in colour. Young stems, on the other hand, are of a brownish colour, and often marked with dark lines. If a bush is very thick and close, and the young stems are twiggy above, and yield small leaves, they should be cut down, say six inches, from the ground; but

the majority of young stems should, as a rule, be only trimmed or cut down to the height required.

In many bushes there will be found springing, straight from the root a few long lanky shoots, which bear their leaves far apart and do not branch. These have probably been unnaturally "drawn up" owing to want of air and light; they are never likely to be of much use, and, if in the way, should be removed.

Young and vigorous trees should be cut down, as has already been said, to a proper height; small wiry twigs cut away, and all good ripe wood kept for the building up of the bush; and it should be borne in mind that the object, as much as any other, is to regulate the vegetation of the bush, and to admit light and air—most essential things for the well-being of tea bushes.

The general principles already touched upon should be carried out, and after the pruner has finished with it, each bush ought to consist of young healthy stems, with fresh-looking bark, which do not branch too much. Each bush, as I have said, should be open enough to admit air and light to its centre, and cut to flat table-like form: experience alone will teach the comparative severity or lightness of pruning which will be most advantageous to the different varieties of tea-plants, and in different soils and situations.

It has not been the object of this paper to treat of other matters connected with tea cultivation.

I would merely say in conclusion that, to ensure success, pruning must go hand-in-hand with deep hoeing, careful weeding and manuring. If these, the essential parts of all gardening and farming, be attended to, the results will be happy in spite of the low rates at which tea is now selling.

Childe Harold.

The leaf-buds becoming hard after the first flush, are, I believe, principally occasioned by water at the tap root, and are not so much due to atmospheric changes of the weather; but it often shows itself after the third flush, when there has been long continued drizzle rain. The right thing to do is to pluck off these hard roots, and dig deep and well, pressing the soil close to the roots. We ought, as in indigo, to have fixed rules for work. I mention this, as "Inquirer" calls pruning in January and February early pruning. This is about the right time, 10th January to 15th March, for the hills of Darjeeling, when the sap is commencing to circulate. Formerly, people pruned in October, November, and December; and all the ends of the trees drew up by the westerly winds, and so many trees were cankered and gave *bhanji* flushes. Higher up the hills, 5,000 and 6,000 feet, it may be right to prune later; but each planter should find out, by experiment of a few trees here and there, what is the proper time for pruning his garden, and not listen to every idle breath of wind he hears. A manager, by idle, careless, mis-called high cultivation, can do a great deal of harm. The Assam Company bury their prunings: so do I, and with great advantage; but the right place to bury them is the question. If on the top of the surface roots close to the stem, then no doubt great damage is done, as above, through fermentation; but if placed some eighteen inches off, at the tip of the surface roots—as all fruit trees in England are done, whose surface roots are pruned to bury them within reasonable space for manuring them—no doubt great good is done.

One of my gardens two years ago yielded 11 maunds per acre. Last year it was manured with guano and bone dust, and yielded only 10 maunds, but never cultivated and plucked so hard that I could not, in pruning, cut off half an inch of young green wood. All that I could do was to thin out the crow's feet brought on by over-plucking. The year before it had yielded 11 maunds with moderate plucking,—that is leaving on a leaf and a bit of a leaf including the buds on each shoot. I do not call this hard plucking; but hard plucking is taking off the first and second flushes—every bit of them, leaving not one young leaf to circulate the sap. The sap is not circulated in the old leaves: they perform functions; but what they are it is difficult to state, except that of keeping the tree warm. Many managers clean all these old leaves off the trees, and leave the trees almost in a state of nudity. This is quite a distinct practice from thinning out crow's feet brought on by bad plucking the year before. Trees so treated have their first and second flush, but appear to be totally exhausted for a third flush. It is

clear from the above that no manure will revive a tree if ruthlessly cleared of its leaves—old and young; and hard plucking gives not a leaf more than is usually given by trees when well treated. See the yield above.

This system of hard plucking, joined to hard pruning year by year, lessens the vigour and size of the plant, and materially lessens the yield. It may succeed for one year, and exhaust previously well-grown trees; but to try it on deteriorated trees is ruination.

In the Kangra Valley the tea bush is essentially a bush. It is highest from 15 inches to 2½ feet: it is not single stemmed, but has a growth of many stems—20 and 30 in some instances—springing direct from the ground or just above it. These stems, from their stunted height, thicken and form cross growth and white wood very rapidly, and have to be thinned out.

In good bushes ¼ to ⅕ of the bush would be cut out—not in the segment of a circle, but carefully and evenly out of the whole bush. In bad bushes, where rapid regeneration is required, a third and sometimes a half is ruthlessly cut away: the symmetry being preserved in a skeleton form. I do not think it is an exaggeration to say that in some of the Kangra Valley gardens the pruning could not be done with greater care or precision, and any one who chooses to look, can see in various plantations large areas of tea, which were pruned at the rate of from 15 to 25 bushes per man per diem, giving later on the most satisfactory results in an improved yield, and what is almost more important, an improved class of leaf. The same system of pruning is adopted at Kumaon and Dehra Dhoon by practical English gardeners, who have increased the yield of their gardens in a most wonderful way: and the secret of this happy result lies in judiciously cutting away old wood from the bottom of the bush, and so forming every year new growth. In a few words, two-thirds of the sap is devoted to making leaf, and one-third to making new wood, which is, as it sounds, a prudential policy for any planter to follow.

Plucking.

Taking off 2½ leaves, counting tip as one, I endeavour to go round on full bearing area, *i.e.*, of bushes 6 years old and upwards, at intervals of about ten days from June to end of October. As the flushes from bushes of that age are seldom quite ready for plucking on this Estate under an average of eleven to twelve days, they are taken off therefore from one to one-and-a-half days before being quite matured, with the object of producing tea of greater strength than would accrue if the leaves were gathered later, and I am quite confident from long practice that the end is attained thereby.

2. If I were left to my choice I should pluck about every ten days, but this I haven't been able to manage this year, the periods ranging to nearer 15 days, and yet I am plucking decidedly fine leaf. I take everything off the bush, when I do come round, for I find this plan forces out a much better flush than would otherwise follow. I would not however venture on this until my bushes are grown, say about the 15th June; up to that date I am careful as to side shoots.

3. No amount of manipulation or "dodges" in the tea house will ever make strong liquoring tea out of bad leaf. To obtain good leaf implies a combination of good soil, good cultivation, good plant, and careful plucking. The point to be aimed at is to get your leaf removed, from the shoot just exactly when the shoot is at the specified stage of growth and no later. Certainly no sooner or it would be detrimental to the plant. I consider therefore that a complete circuit of the garden should be made by the pluckers once a week, if possible, and not later than once in nine days, if quality and quantity are to be as nearly as possible combined; but great care must be taken by the Manager not to let the pluckers take shoots which are younger than he intends they should be, and that each shoot plucked comprises two leaves and a bud, *and not less*. When the leaf is got in at its correct stage of growth its manufacture is very easily managed, and if two leaves and a bud only are taken, it will all fairly classify, with very little breaking up into Pekoe and Broken Pekoe, because it will all be found to contain sufficient strength of liquor to thoroughly entitle it to be classed as Pekoe.

4. Condemns plucking between flushes, says there is one real and one intermediate flush every 28 days, and that both nature and experience are against ten days' plucking.

5. Argues that it is upon the developed leaves the trees chiefly depend for their vital action; the very young leaf is rather feeding upon the parent than itself acting as a vital organ. So by pinching off the tops as often as you can, stronger development is attained.

6. Pekoe Souchongs are fetching 7 to 8 annas only, while Souchongs and Broken

teas command 6 annas. Quantity therefore is quite as much an object as quality, and the more large soft leaf that is taken the better, especially if it can be manufactured separately. My bushes flushed about every fourteen days and they are plucked accordingly.—*Indian Tea and its Manufacture.*

MANURE.

EVERY substance which has been used to improve the natural soil, or to restore to it the fertility which is diminished by the crops annually carried away, has been included in the name of manure. Thus chalk, marl, clay, and even sand, when added to the soil for the purpose of improving its texture, have been called manures; and some confusion has arisen in our ideas in consequence of applying the same word to signify things which are essentially different. The French have a term by which they distinguish the substances which merely improve the mechanical texture of the soil from those which act more directly in nourishing the plants which grow in it. The former of these they call *amendements*, and the latter *engrais*.

It is well known to all practical agriculturists that the texture of the soil and the proportions of the earths of which it is composed are the first and most important conditions of its productive powers. When there is a good natural loam which retains moisture without becoming wet or overcharged with it, and permits the influence of the atmospheric air to pervade it, the crops cannot fail to be more certain and remunerating than in loose sands or tenacious clays, however rich they may be in those substances which are supposed to supply the elements from which the juices of plants are chiefly composed. But, at the same time, it is equally true that the best texture of soil will not produce good crops for any length of time without the help of some other rich manure to recruit the loss produced by vegetation.

The various means of improving the texture, such as tillage and the mixture of earths, are treated of separately. [TILLAGE; SOIL; LOAM; MARL.] We shall here confine our observations to that class of manures, which stimulate or enrich the soil.

There are some substances which evidently belong to both classes of manure. Of these, lime, either in its caustic state of quick-lime or its milder form of a carbonate or chalk, is the principal. Lime, being an earth less porous than sand, and more so than clay, has an improving effect on soils in which either sand or clay prevails; but it has also a chemical effect as an alkaline earth; and, considered in this light, it acts on the soil in a peculiar manner, and greatly assists the effect of enriching manures, which are all of animal or vegetable origin.

Lime as a manure acts most powerfully in its caustic state—that is when deprived of the carbonic acid which is generally united with it. The carbonic acid is expelled by the heat of the kiln, and limestone is by this means reduced to the state of quick-lime, in which it has so strong an attraction for moisture and carbonic acid, that, if it be left exposed to the atmosphere for any length of time, it absorbs both from it, and gradually returns to the state of hydrate and carbonate, or lime united with water and carbonic acid, with this difference, that it is now a fine impalpable powder, instead of a hard stone.

Among the purposes it serves, and besides its use as a direct food of plants, are those comprised in its relations to the dormant and mischievous ingredients of soils; its power to detach serviceable alkaline matters from useless positions in the soil; its power to induce the decomposition of vegetable matter there; its power to decompose and render harmless mineral and metallic salts of a mischievous character; its uses in detaching ammonia from comparatively insoluble compounds of it, and so presenting portions ready for immediate use

by the plant; its influence in possibly increasing the power of soils to absorb ammonia from the air.

Besides all this, its influence on the texture of the soil, on the growth of weeds, on the general fertility of the land, on the growth especially of particular crops, should be also named.

The use of frequent limings in small doses, as compared with larger dressings at longer intervals, depends on the quantity of vegetable matter in the soil, but the larger dressings are generally to be preferred, on the grounds that in practice the full influence of a liming is not seen until after several years, and that the abundant fertility which, when lime is properly used, is consequent upon its use, may, when rightly managed, be made to reproduce itself, and so become permanent. The abuses to which it is liable are, chiefly, its application to soils deficient in vegetable matter, and its application along with manure rich in ammoniacal matters. But a distinction may be drawn between rotten dung and recent farm manure in this respect,—the application of hot lime along with the former being wasteful, but along with the latter by no means uneconomical. There are many modes of applying lime, as slaked or unslaked,—in compost with vegetable matter of any kind, or directly to the land, ploughed or hoed in deep or shallow, in quantities of 40 or of 240 bushels per acre, &c. One of the best rules of practice is, to apply it where there is the greatest quantity of undecomposed vegetable fibre in the soil.

The use of quick-lime in rendering inert vegetable fibres soluble, and hastening the decomposition of animal substances, is of the greatest importance in agriculture. Substances may be rendered highly enriching in a short time, which, without it, would have lain long dormant in the soil or the dung-heap. Its effects in this way will be more particularly noticed when we treat of composts.

Wherever there is peaty matter in the soil—which, owing to the tannin principle which it contains, is, by itself, perfectly incapable of putrefaction—lime is the true remedy. On the other hand, in a very stiff clay, chalk or lime will render it much more porous, and admit the influence of the atmosphere; it will correct acidity, and assist the nutritious effects of animal and vegetable manures. Quick-lime spread on a soil abounding in vegetable matter will make it active by dissolving the half-decomposed fibres and converting them into a soluble mucilage: being extremely minutely divided by its property of attracting moisture rapidly, a very small quantity produces an immediate effect. Hence it is generally spread over fallows which are preparing for sowing. If it were put on the land long before the seed is sown, it would have lost its chief and immediate power by attracting carbonic acid and returning to the state of carbonate or chalk, and all the expense of burning would be thrown away, except as far as it has thoroughly pulverised it. But frost does this with chalk spread before winter at a much cheaper rate; and a good dressing with chalk will last in the soil, and its effects be preserved, many years after all the lime would have disappeared. It is, therefore, a matter of mere experiment and calculation whether it be more profitable to put ten cart-loads of chalk on an acre of stiff clay, or one or two cart-loads of quick-lime. If the soil be very tenacious, the chalk will probably be the most profitable in the end as well as the cheapest; but for a few crops the lime may appear to have the advantage. Everything depends on situation, and the comparative facility with which lime and chalk can be procured.

On poor sands chalk will be found to produce a greater and more permanent improvement than the same value in lime, which, unless it be mixed with clay or vegetable snbstances, will not be of great use on such soils. When marl can be procured, or clay and chalk, these will be the best correctives for the porous nature of sand, whether mixed by nature or artificially. But marls are chiefly "amendements," and as such will be noticed separately.

It may, however, be mentioned here, that experience in the use of lime has varied exceedingly owing to two causes; one of which is that limes vary exceedingly in their qualities, and the other, that crops vary exceedingly in their need of lime. The latter of these particularly points to the use of lime as being directly the food of plants, and thus more influential for one crop than another. On the former we may merely state that analyses of lime from quarries in different parts of Great Britain, show that the quantity of lime present varies from 60 to nearly 100 per cent. And an even more valuable ingredient than lime in certain limestones, namely, phosphate of lime, certainly adds largely to the fertilising influence which certain limestones exhibit. Thus in Connemara, Mr. Whitwell of Kendal has had various limestones analysed, with the following results:—

	1.	2.	3.	4.	5.	6.	7.	8.
Phosphate of lime ...	7·16	13·8	3·5	14·8	8·5	8·3	13·7	2·0
Silica ...	...	46·5	82·3	20·2	2·6	41·4	8·4	44·0
Sulphate of magnesia ...	...	3·0	...	...	...	0·9	...	...
Chloride of sodium ...	...	2·0	...	...	...	...	...	...
Potash ...	...	5·0	...	...	4·6	...	...	...
Carbonate of lime ...	...	...	8·0	43·8	49·3	...	74·3	...
" magnesia ...	...	31·8	4·2	21·2	35·0	49·4	3·6	5·0
Moisture ...	...	...	2·0	...	...	...	...	...

It is plain that differences of this kind must produce very great differences indeed in the fertilising influence of the lime we apply. A limestone containing only 68 per cent. of lime, such as some of them near Dublin, will be of less value than a Durham limestone containing 94 per cent. (just as 68 is less than 94) in respect merely of the effect of the caustic calcareous matters on the soil; but if, apart from this mere carbonate there be present a phosphate in any quantity, an effect of an altogether different and valuable kind must follow its application. The mineral phosphate which, while in the masses of the rock, would be comparatively useless, must, when broken down to powder as by burning and slaking the limestone rock, it becomes, be so laid open to the influence of the solvents of the rain and air, as to act upon the plants like a dressing of bones. Then, again, consider the effect of a large quantity of magnesia, which, when caustic, acts more slowly but more persistently—and you cannot doubt that the composition of the limestone you employ must be looked to for much of the explanation of the results of its application.

But apart from the general influence of lime on the soil there is to be considered the relation in which it stands to the several crops the farmer cultivates.

Immense differences exist among our agricultural crops as regards the quantity of lime which they contain. Thus the ash of wheat-straw contains 6 per cent. of lime, of barley-straw 8 per cent., of rye-straw 9 per cent., and these crops accordingly do not take more than 10 to 15lbs. of lime out of an acre by the growth of an ordinary bulk. Bean-straw, on the other hand, or rather the ash of bean-straw, contains 21 per cent. of lime, the ash of the pea 55 per cent., of the vetch 38 per cent., much larger quantities, and so an ordinary crop of beans and peas respectively will take by means of the one 38lbs., and by means of the other 190lbs. of

lime from the acre. Both of these crops, therefore, on the ground of direct use of the lime for food, require a larger quantity of calcareous matter in the soil.

Take now the case of some of the root crops: we have in turnips, bulb and top respectively, lime to the extent of 11 and 23 per cent. of their ash respectively; in the case of mangold a smaller quantity, namely, 3 and 8 respectively; in the case of the potato, 2 and 17 per cent. respectively; in the case of the carrot, 8 and 32 per cent. respectively; in the case of lucern again, which especially prospers on calcareous soils, one-half of its ash is lime. An examination of the ash analyses of plants shows the composition of the crops which they indicate to tally with agricultural experience as to the character of the soil they prefer. Thus the ash of the lucern contains 50 per cent. of lime, and that of sainfoin 29 per cent. These figures accordingly prove that the influence of lime as a manure does, to some extent, depend upon its power to supply plants with direct food.

We turn now to the more direct manures—those which really contribute the bulk of those materials towards the growth of plants in which the natural soil and air, the only other sources of nourishment open to them, are deficient.

The first and most important class of manures are the excrements of animals. The peculiar property of earth in absorbing putrid effluvia and removing disagreeable smells, appears an indication of nature to lead us to bury putrid animal substances, of which the excrements and dead carcasses of animals are the most numerous and obvious. It would require no length of experience to show that wherever this is done, vegetation is more vigorous. There is, therefore, another motive for burying dung than merely to get rid of a disagreeable substance. From the most ancient times, of which there are any records, the dunging of a field has been an important part of cultivation. The preparing of the dung of animals, so as to render it more efficacious, is a later improvement, and has not yet attained the perfection of which it is capable, unless it be so in China, of which we read wonderful accounts. The fresh dung dropped on the ground, far from improving the herbage where it has fallen, appears to injure it, and render it unfit for cattle to eat; when it gradually disappears, and not till then, the spot is restored to its former verdure. But if the dung be dug into the ground and covered with earth, the fertilising effect will be immediately perceived. This is a sufficient lesson to the husbandman to make him bury the dung as soon as possible. But this not being always practicable, it is collected in heaps until it can be carried to the land prepared for its reception by ploughing or digging. By mixing the straw, which has served as litter to cattle, with their dung, the quantity is increased, and by allowing this mixture to heat and putrefy a greater quantity of manure is produced. This is probably the history of the dung-hill. In the making of a dung-hill, experience has taught methods which accord well with what science might have taught. The manure must be soluble before it can be effective; this solubility can only be produced in the more solid portions, such as the straw, by putrefaction, which the dung promotes when duly moistened. The exact moment when it is most advantageous to bury it in the ground, in order to its greatest immediate effect, seems not yet fully decided. Some let the decomposition go on until a great portion of the heap is converted into a black, tough, greasy substance, which, from early association, gives the idea of richness. It is no doubt a powerful manure which acts speedily, but is it the most economical? This may be disputed. A great portion of the substance must have been resolved into gases, which fly off and are lost. The remainder, evidently carbonaceous from its colour, has acquired too much of the appearance of charcoal to be very efficient; and it is only

the exuding juice which is immediately fertilising. The most experienced farmers agree, that whenever the brown colour of a dung-heap verges towards a black, the dung has lost something of its value, besides the diminution in its bulk by dissipation. The best state in which dung can be carried to the land, for an immediate as well as permanent effect, is when the straw is so rotten that it readily breaks into short pieces, without having entirely lost its form: it should then be of a brown or mahogany colour, uniform throughout the mass. Whenever dung is mentioned by foreign agricultural writers, it is generally understood to be in this state, which in English is called short dung. It must, however, be admitted that farm practice is more and more sanctioning the doctrine of the chemist, that it is true economy to bury manure as soon as we have it.

Autumn application of fresh dung is found more efficient and economical in the long run than the ordinary wasteful management of the dung in heaps. Nevertheless, as manure is wanted for the land at different seasons, it is of consequence that the dung from the yards and stable should be collected in such heaps, and managed so as to be in the exact state which is thought most advantageous at the time when it is carted on the land. To effect this some attention is required. The oldest portion must have its putrefaction retarded, and the newest accelerated, to bring them both to the same state. This is easily done. If a certain thickness of dung is kept trodden down by the cattle, it will be a long time before it decomposes, nor will it do this without being turned over to expose the under portions to the air. If, on the contrary, it be carried out into a heap in a loose state, and occasionally turned over and moistened when it appears dry, it will heat and be ready in a very short time. When a sufficient quantity of short dung can be carried to a field prepared to receive it, and immediately hoed or ploughed in with a shallow furrow, it will soon incorporate with the soil and afford a succession of soluble matters, which will give regular nourishment to the plants. This is said on the supposition that the soil is in that state when it only requires replenishment, and has a texture favourable to the crops raised upon it. In poor sands or wet clays some modification in the state of the dung may be necessary.

In speaking of dung, we have not said anything of the different kinds of dung produced from different domestic animals. In some cases it may be advantageous to keep these separate: for instance, the dung of cows from that of horses; of cattle feeding on oil-cakes or grain, with or without turnips, and those fed on straw or refuse hay only. Cow-dung, when in a fresh state, is thought best for light soils, and horse-dung for cold heavy soils. But in general a mixture of the dung of all the different animals kept on a farm with all the straw that can be afforded, will give a manure of an average strength, which may be used upon all kinds of land; with this difference, that for light soils it should be more decomposed than for the heavy, and also hoed in deeper; for the air penetrates the light soil to a greater depth, and sooner acts on the manure. In heavy land the straw, if not so much decomposed, will form cavities to let in the air, and facilitate the disintegration and tilth of the soil. All this is well known to most farmers, but not always strictly attended to. It is better to manure slightly and often than to put on a large quantity at once, except for some particular crops, which require a rich earth, and consume much manure, such as potatoes, &c. Manure is to a tea-garden what daily food is to an animal; it must be procured at any sacrifice. It is better to let an old and exhausted plot of tea remain uncultivated rather than to break it up without having the means of manuring it. A little leaf may be obtained, but the land is deteriorated and what is obtained from it is dearly paid for.

Various means have been adopted to increase the efficacy of manure. The

simplest is to husband the manure of cattle, obtained from their stalls, either by keeping the litter and more solid parts of the dung separate from the urine and liquid parts, which are collected in large reservoirs, and used in the liquid state, or by putting litter daily so that it accumulates under the animal and absorbs the whole of the solid and liquid excrement. The liquid manure system is not gaining ground in farm practice, and it seems to be generally allowed that the best mode of saving it is in the litter of cattle; the dung thus formed containing the whole of it, in a form to which the ordinary practice of the farm is already adapted. A word or two must nevertheless be said on the uses of liquid manure.

Notwithstanding some apparently contradictory opinions, it is pretty generally acknowledged by those who have had long experience of its use, that urine and similar animal substances have a more powerful effect on the soil, when they have undergone a certain degree of putrefaction, than when they are used in a fresh state, and that this is produced with the least loss of substance when the liquid has been confined in close vaulted cisterns which admit the external air only partially. On light soils this liquid has a most fertilising effect, if it is used frequently in small portions at a time. On very heavy soils this effect is not so apparent, and for such soils the liquid is accordingly mixed with sand or any light earth before it is applied; or, instead of using it at once upon the land, it is poured over the litter, which has been collected in a heap or in a yard, after having served for the cattle. This litter, having been deprived of the urine which would otherwise have mixed with it, would rot very slowly and produce a very inferior kind of manure, unless it were moistened, and fermentation were excited by pouring the half-putrefied urine over it. It may be objected that if the urine is only collected to moisten the straw which has served as litter, it would be as well to let it be mixed at first, without the trouble of pumping it up and the expense of a cistern to hold it. But we shall soon see that there is a very wide difference. In the common mode of collecting farm-yard dung, the straw is very unequally impregnated with animal matter: at one time it will contain a large portion and run rapidly into fermentation; at another, there will be so little, that it is with difficulty that heat is excited in it. By separating the urine and litter, the straw will go much further, and can be mixed with the urine at the most advantageous time; thus it forms a much richer manure in a smaller compass, from not being so much diluted with water. Should there be a deficiency of straw, earth or sand will supply its place, in as far as soaking up the rich juices; for the addition to the manure from the decomposition of the straw itself is very small in proportion to that which animal juices afford. If the liquid is collected from a stable or a yard where cattle are kept as soon as it is produced, and is carried off into a cistern, there will be a much better and drier bed left for the cattle, especially if the rain be kept off by light shades. When the litter is soiled to a certain degree, it may be removed to a heap in a proper place, where its conversion into rich dung may be effected by the addition of putrefying urine, than which nothing will so soon rot vegetable fibres, if the air be admitted to the heap. The portion which is not wanted for some time may be left to decompose more slowly; and, as the time approaches when it is wanted for the land, it may be managed so as to be in that state which experience has shown to be most effective in the improvement of the crops.

There is some appearance of certainty and regularity in this mode of making a dung-hill, which there scarcely is in the common practice of accumulating straw, dung, and urine without any regularity in a farm-yard, turning it over when the cattle leave it for the pastures, and carrying so many cart-loads per acre on the land

to be manured, without any measure of its comparative strength. One portion is often almost burnt black and another appears like the fresh litter of the stables, not being even thoroughly soaked with moisture. It is true that good farmers pay more attention to their dung-heaps, and endeavour to carry out the manure in a proper state; but how much more readily would this be accomplished by the help of a large cistern full of the richest animal matter in a state of partial putrefaction. In situations where straw bears a high price, it may be doubtful whether a cistern might not permit a considerable profit to be made by the sale of a portion of the straw, without any diminution of the manure required for the farm, since for light soils the liquid might be used alone, and for stiffer soils it might be mixed into a compost with earth, chalk, and any kind of refuse vegetable matter of less value than straw. It was an opinion expressed by a celebrated agriculturist* to the late Mr. Rham, that he considered the use of straw in dung to be merely as a sponge to hold the liquid animal matter in its pores or tubes. In fact, straw or old thatch, merely rotten by long exposure to air and moisture, is of little or no value as a manure, although it will sometimes produce good potatoes, by rendering a stiff soil pervious and porous; but, in a light soil, a gallon of urine is worth ten times its weight of rotten straw. Thus doctrine may appear strange to some agriculturists, but it will bear the test of experiment.

It is well to add here the conclusion to which Dr. Völcker's researches into the composition and management of yard manure have led him. We extract them in an abridged form from his papers in the 'Journal of the Agricultural Society':—

"Perfectly fresh farm yard manure contains but a small proportion of free ammonia.

"The nitrogen in fresh dung exists principally in the state of insoluble nitrogenised matters.

"The soluble organic and mineral constituents of dung are much more valuable fertilisers than the insoluble. Particular care, therefore, should be bestowed upon the preservation of the liquid excrements of animals, and for the same reason, the manure should be kept in perfectly waterproof pits of sufficient capacity to render the setting up of dung-heaps in the corner of fields, as much as it is possible, unnecessary. Farm-yard manure, even in quite a fresh state, contains phosphate of lime, which is much more soluble than has hitherto been suspected. The urine of the horse, cow, and pig, does not contain any appreciable quantity of phosphate of lime, whilst the drainings of dung-heaps contain considerable quantities of this valuable fertiliser. The drainings of dung-heaps, partly for this reason, are more valuable than the urine of our domestic animals, and, therefore, ought to be prevented by all available means from running to waste.

"The most effectual means of preventing loss in fertilising matters is to cart the manure directly on the field whenever circumstances allow this to be done.

"On all soils with a moderate proportion of clay, no fear need be entertained of valuable fertilising substances becoming wasted if the manure cannot be ploughed in at once. Fresh, and even well-rotten dung contains very little free ammonia; and since active fermentation, and with it the further evolution of free ammonia, is stopped by spreading out the manure on the field, valuable volatile manuring matters cannot escape into the air by adopting this plan. As all soils, with a moderate proportion of clay, possess, in a remarkable degree, the power of absorbing and retaining manuring matters, none of the saline and soluble organic constituents are thus wasted, even by a heavy fall of rain. It may, indeed, be questioned whether it is more advisable to plough

* Mr. De Fellenberg, of Hofwyl, near Berne, in Switzerland.

in the manure at once, or to let it lie for some time on the surface, and so give the rain full opportunity to wash it into the soil.

"It appears to me a matter of the greatest importance to regulate the application of manure to our fields, so that its constituents may become properly diluted and uniformly distributed amongst a large mass of soil. By ploughing in the manure at once, it appears to me, this desirable end cannot be reached so perfectly as by allowing the rain to wash in gradually the manure evenly spread on the surface of the field."

Among other conclusions regarding the common management of dung-heaps to which Dr. Völcker leads us, are the following:—During the fermentation of dung, the phosphate of lime which it contains is rendered more soluble than in fresh manure. In the interior and heated portions of manure-heaps, ammonia is given off; but, on passing into the external and colder layers of dung-heaps, the free ammonia is retained in the heap.

Ammonia is not given off from the surface of well compressed dung-heaps, but on turning manure-heaps it is wasted in appreciable quantities. Dung-heaps, for this reason, should not be turned more frequently than absolutely necessary.

If rain is excluded from dung-heaps, or little rain falls at a time, the loss in ammonia is trifling, and no saline matters of course are removed; but if much rain falls, especially if in heavy showers, upon the dung-heap, a serious loss in ammonia, soluble organic matter, phosphate of lime, and salts of potash is incurred, and the manure becomes rapidly deteriorated in value, whilst at the same time it is diminished in weight.

The worst method of making manure is to produce it by animals kept in open yards, since a large proportion of valuable fertilising matter is wasted in a short time; and after a lapse of 12 months, at least 2-3rds of the substance of the manure is wasted, and only 1-3rd inferior in quality to an equal weight of fresh dung, is left behind. The most rational plan of keeping manure in heaps appears to be that adopted by Mr. Lawrence, of Cirencester, and described by him at length in Morton's 'Cyclopædia of Agriculture,'—which consists essentially in adding each day's store to a narrow heap, and covering it with earth, at once, completing the heap as you go.

The great use of liquid manure on light soils is to impregnate them with soluble matter, which being diffused through their substance, supplies nourishment to the roots of plants, wherever they may shoot out. It may be applied to the land at any time before the seed is sown, and soon after, when the blade springs up or the seed begins to form; in short, whenever the plant requires fresh nourishment, or when that which existed in the soil is diminished. Without liquid manure, the poor silicious sands of Flanders could never be cultivated, much less produce crops which vie in quantity and quality with those on the best soils. The quantity of farm-yard dung, in a very rotten state, which this soil would require according to the common system of manuring, could never be produced by all the straw which can be raised upon it in its first state of cultivation. But cattle produce urine, and this produces roots for cattle. The great effect of liquid manure has set the farmers on finding some artificial substitute for the simple urine and diluted dung of cattle. Such substitutes are obtained by mixing all kinds of refuse animal matter with water, and inducing putrefaction. The emptyings of privies from town is scarcely a substitute; for it is the same as the liquid from the stables in a more concentrated form; but the refuse of oil-mills and various manufactures, when diluted and mixed with a portion of putrid urine, soon become assimilated to it. This becomes a branch of trade in those countries where nothing will grow without manure, and is a resource

where an increasing population demands the cultivation of inferior soils to supply the necessary increase of food, as well as an increase of produce from those which are naturally fertile.

The increase of manure by the formation of *composts* is well known in many parts of Britain, and by their means the land has in many districts been rendered much more productive. The fundamental principle upon which composts have been made, is that of impregnating portions of earth with those parts of the dung of cattle, which, from want of management in the common dung-hills, would have been dissipated and lost; and also accelerating or retarding the decomposition of animal and vegetable substances by the addition of earths, such as chalk, marl, clay, and even sand, according to the nature of the soil on which the compost is to be used. All solid manure which is to be ploughed into the ground should contain certain parts already soluble in water, which promote vegetation, while other portions should be in a progressive state, so as to afford a succession of soluble matter by a gradual and slow decomposition.

Liquid manure, however active and immediately effective, soon loses its power; whereas solid dung, well prepared and ploughed into the ground, will last for several crops. It is the judicious use of both these manures, conjointly, which has the best and most permanent effect. The dung or compost, having been ploughed in well, requires some time before it can have any direct effect on the germination of the seed, or the nourishment of the plant. The liquid, on the contrary, acts from the moment it is poured on the surface. It is the milk of the young plant, which thrives upon it, and stretches out its fibres through the earth, till it reaches the dung, which is now in a proper state to supply the more vigorous roots with sufficient nourishment. It is evident that the growth must be more rapid and regular, and not so liable to be checked for want of proper nourishment, nor are the young roots in danger of perishing by being too soon exposed to the immediate contact of rank dung. Every exertion should, therefore, be made by the industrious husbandman to increase the quantity and improve the quality of every species of manure both solid and liquid: and here careful experiment can alone be depended upon.

In the formation of composts the principal objects are, to regulate the decomposition of the organic substances, and to increase the bulk of the manure by means of less expensive materials than straw. For these purposes lime or chalk is generally used: the former, in its caustic state, to accelerate the decomposition of fibrous matter; the latter to add to the mass, and absorb any portion of acid, which is always produced in a certain stage of the fermentation. The mode of doing this is so generally known, that it is needless to describe it: we shall only observe that the stiffest clay may be used with advantage in composts, where better soil is not at hand; and for light lands, the stiffer the clay the better, provided it be thoroughly incorporated with the manure. The most useful material, under proper management, is vegetable soil or turf. This may be laid in layers with quick-lime and earth; the whole being well soaked with liquid manure. If any kind of vegetable matter, such as fern, pond-weeds, &c., can be added, it will be so much the richer. The lime and urine acting decompose and transform it, the woody fibre is dissolved, and the whole mass, when turned over and well mixed, becomes a very rich earth, which being spread on the land and slightly ploughed or harrowed in greatly enriches its surface. By this means many poor soils may be improved, where the cultivation is not sufficiently extended to produce straw.

Although bones have been treated of in a separate article [BONES], it may be proper to mention here, that if some easy means of dissolving their

substance were discovered, they might be made of much greater use than they now are. At present they are put in with the seed in a broken state, and as they remain a long time undecomposed in the soil, their effect, after the first crop, is scarcely perceptible, unless a very large quantity is used. By mixing dissolved bones in a liquid state with earth, almost all the component parts of urine would be there.

Besides an immense number of waste substances now used in manure, we have, in guano and other imported fertilisers, means of replenishing our soils of which the agriculturists of thirty years ago knew nothing, and to some of them we must now make some reference. But first it may be named that the ashes of vegetable substances which have been burnt are very effective in stimulating vegetation. They are chiefly used as a top-dressing on young clovers and grasses; and wherever there is an appearance of sourness in the grass, wood-ashes are of great use. It is however seldom that wood-ashes are used as manure until the greater part of the alkali has been extracted; but when the surface of the land is pared off, and the dry sods are burnt, the ashes which result from this operation are very effective in producing a good crop without any other manure. [PARING AND BURNING.] The refuse ashes from bleachers' and soap-boilers' premises have still some portion of alkali in them, and, as they contain lime and other earths in a very divided state, their effect on the soil is very perceptible. Sea-salt has been extolled and decried at different times, owing probably to the different circumstances under which it has been tried. Mangold-wurzel undoubtedly benefits by its application; and one or two cwts. per acre, in inland situations, will benefit other crops as well. Quick-lime slaked with salt water is a powerful manure. What a number of things may be used, and turned to good account as manure, is apparent from the mere list of them:—Animal, vegetable, and mineral substances existing upon the estate; roots, prunings, and fallen leaves; jungle grass, fern leaves, moss, river weeds, sods and turf; saw-dust, spent bark, and peat, when properly decomposed. Many of these contain nitrogenous ingredients in larger proportion than the straw of grain, and several of them are equally rich in the mineral constituents of plants. Animal substances, such as carcasses, blood, bones, fat, waste fish, sprats, and various shell fish, are, in particular places, to be sometimes had abundantly. They all contain nitrogen, and so are capable of forming ammonia in larger quantity than our highly valued farm-yard dung. Mineral substances also are available: earth from hedges, scourings of ditches, banks, ponds, &c., containing a large share of vegetable matter, and road-scrapings are also elements of composts. Many refuse substances of trade and manufactures are also available in this way: woollen rags, shoddy, soapers' waste, soapers' ley, paper waste, glue refuse, and refuse of salt-works, of starch-works, sugar-works, slaughter-houses, cider-mills, gas-works, &c., may thus all be used. Many of them are not fit for use in their natural state; but in compost with others, and suffered to rot there, they become useful.

Composts, too, are useful as diffusing and diluting stronger applications: guano may thus be economised. They exercise a beneficial influence on fertility, in virtue of their mechanical effects upon the soil. Stiff soils may thus be improved by vegetable composts and light soils by heavy composts. Lime, of course, is a chief ingredient in composts, and has been already adverted to. Let us, however, call attention to the labour of making and carting bulky and comparatively poor manures, as composts generally are, in order to defend the greater economy as a general rule of purchasing artificial fertilisers, in order to supplement the deficiency of what may be called the natural supply.

What an immense variety of artificials, so-called, which the farmer has

now at his command, is apparent from the following list:—

Guano.	Nitrates of soda and potash.
Bones.	Gypsum.
Superphosphate.	Salts of various kinds.
Blood manure.	Soot and charcoal.
Wool manure.	

Guano may be applied to almost every crop with advantage, and it is well to mix it with mould for diluting it, or with common salt for preserving it. M. Barral, a well known French agriculturist, "exposed to the air, for fifteen days, equal weights of guano and of guano mixed with half its weight of common salt, and he found that pure guano lost 11·6 per cent. of its nitrogen during that time, while that mixed with salt had lost only 5 per cent." And Mr. Northcote's conclusions are, that "agricultural" salt is an energetic absorbent of ammonia, both on account of its chloride of sodium, and on account of the sulphate of lime which it contains; and that the quantity of lime salt present especially, most powerfully affects its action in this way. Its agency, however, does not seem to be a very permanent one, though it will collect and retain the ammonia long enough, probably for agricultural purposes.

When thus mixed with a substance which at the same time that it fixes more or less the volatile ingredient of guano, does also increase the bulk of the manure, and so enable its more even distribution over the land, it should be applied during, or immediately before the season of most rapid growth.

Of all the other artificial fertilisers now available in agriculture, that which most directly comes in competition with guano is the nitrate of soda, of which it is probable that large supplies may become avail able, especially from Peru. The nitrates of potash and soda are applied at the rate of about 1 cwt. per acre, and especially on poor lands they wonderfully increase luxuriance of growth consequently the yield per acre, although it is especially influential in the case of poor lands, yet it is also of great service on fertile soils well-managed.

The only reason why nitrate of soda is preferred to nitrate of potash depends upon the greater cost of the latter. The proper time for sowing either is during the period of rapid growth; they, like all soluble manures, are immediately spread throughout the soil by the showers, and of course are liable to waste unless the plant to which they are applied be ready to use them at once. Both of these salts are liable to adulteration, and common salt is the chief substance used for this purpose; its presence is detected on throwing any of it on some hot coals by the crepitating sound which follows. Pure nitre burns the coal up without any of these little explosions.

We come now to the use of bones as a manure. Raw bones contain perhaps half their weight of phosphate of lime; when burnt they contain perhaps 60 or 65 per cent. of phosphate of lime. It is chiefly for this phosphate that the bone manure is valuable, and as in addition to the greater quantities of phosphate which burnt bones contain, they are also superior as regards the facility with which they can be decomposed, burnt bones are more valuable agriculturally than raw ones. This phosphate exists in the mineral world both as fossils and simply in the mineral form; some of the fossils contain half their weight of phosphate of lime; and apatite, a mineral phosphate imported from Norway and America, contains upwards of 90 per cent. of phosphate of lime. It is, however, in its natural state almost valueless as a manure, owing to its insolubility; and as the agricultural value of bones can be greatly increased by increasing their solubility, so whatever value this mineral phosphate possesses is conferred upon it by the same process.

This process consists in the adoption of means which shall have the effect of reducing the material to a fine state of division. When the phosphate of lime is acted on by sulphuric acid one-half the lime is taken from it by the acid, and so sulphate of lime or gypsum is produced; the other half of

the lime, in combination with all the phosphoric acid, forms what is called superphosphate, which is characterised by its solubility in water; and, although when it becomes mixed with the earth when put on the land, this extra quantity of acid becomes neutralised by the lime or the alumina of the soil, yet having been once decomposed the bone-earth retains so exceedingly finely divided a state that rain is able to act upon it as a solvent much more powerfully. The reason why bone-dust is more powerful as a manure than the original bones is, that its finer division gives a larger surface for rain water to act upon, and wash off a portion of its substance as food for plants. Ground and fermented bones are thus more immediate in their action. For further remarks on the use of bones and guano we refer to articles on those subjects. It is to them that we mainly look in this country for the means of supplementing the natural supply of manure on the farm.

It is not worth while going into any detail regarding the particular fitness of other special manures. In practice no reader is likely to go into the manure market for sulphate of magnesia and soda, nor even for silicates of potash and of soda; though these are said to be directly useful in strengthening straw. If the farmer can get a supply of guano, bone dust, superphosphate, and nitrate of soda, to supplement farm-yard dung, he is not likely to go further.

As to the value of special mixtures of different salts on manure, certainly the fancy for that kind of thing ran wild some years ago, but the relative values of manures are becoming now better understood. It is, however, right that we should say a word on soot as a manure. It is used everywhere with good effect in virtue of the gypsum which it contains, and in virtue of the small quantity of ammoniacal salt which it retains as driven off from the coal.

Leaving now the subject of auxiliary manures—which has latterly become one of the most important in the whole range of agriculture—we recur once more in conclusion to the ordinary farm practice connected with the annual replenishment of the soil. Buildings should be so made as to remove all the water which falls upon the roofs, that it may not dilute the manure made in the yards. Their yards, if any are open, should be small and partly covered. Arrangements for feeding in boxes where all the excrement is absorbed by the litter are to be preferred; and where yard-manure is made, or stall-fed cattle have to be daily cleaned out, the manure thus daily made should be daily removed to heaps.—*English Cyclopædia.*

MANURING.

MANURING, in horticulture, requires to be considered in a somewhat different light from that process as applied to agricultural purposes. This is necessary because of the variety of plants, possessing different constitutional habits, to which the gardener is required to turn his attention, and also because of the different results which are expected in horticulture and agriculture. In preparing the present article, the writer has confined himself to simple practical facts, and has adverted only occasionally to chemical explanations.

The gardener is called upon to cultivate species from almost every kind of soil on the surface of the globe, intermediate between the shifting sands of the desert and the most fertile alluvial land continually enriched by the decay of vegetable and animal substances. It is, therefore, obvious that considerable caution is requisite in applying manure, and in determining the quantity or quality suited to the respective constitutions of the various subjects which the horticulturist takes under his care. Thus, although many plants can

scarcely receive too much manure, others, such as the resinous trees, may be actually killed by it.

The kind of manure chiefly used, and frequently the only kind procurable by the gardener, is that derived from the farm-yard, consisting chiefly of the dung of horses or of horned cattle, more or less mixed with litter. Formerly it was very generally the custom to take advantage of the heat resulting from the fermentation of such dung in hot-bed forcing, and there are still some objects for which this kind is found preferable [Hot-Bed]; but since the hot-water system of heating has received so many improvements, the continued fermentation and consequent degree of decomposition which dung undergoes in hot-beds is rendered a less important means of obtaining artificial warmth, and consequently it becomes the more important to enquire whether manure is most beneficially applied in a state of decomposition, as some have advocated, or in a state as recent as possible, no fermentation being permitted previous to its deposition in the soil.

If dung contains a large proportion of litter, and particularly if the latter be in a dry state, it will be advisable to subject it in nearly all cases to a moderate degree of fermentation, assisted by a sufficient quantity of moisture, in order that the fibre of the straw may be reduced to a state permeable by the spongioles of plants, and either become sufficiently dissolved for affording nourishment itself, or serve in the first instance as an absorbent reservoir for substances of still greater solubility. Where such preparation has not been attended to, litter has been frequently observed, when turned out of the ground after a dry summer, to be still in a dry musty state, having evidently been of little benefit to the crop; and in the case of many plants, which require much manure, litter in this state would actually prove very injurious. But if the dung be what is termed short, containing little straw, and that well saturated with the liquid proceeds of the stalls, it may be dug in without fermentation for most kitchen garden crops, provided it is well divided and properly mixed with the soil in digging or trenching in. This is necessary in all cases, but more especially so when the manure is applied fresh; for disease is often induced by the roots entering into masses constituted of particular substances which either wholly or, at all events, too powerfully predominate over the proper nutritive solutions.

But, on the other hand, if the soil is of a wet and stiff nature, then long unrotted dung is most proper, because its straws form so many minute drains, which, to speak technically, keep the ground open; and in such soils, by means of littery manure and drilling, a crop of potatoes, for example, can be raised very superior in quantity and quality to that obtained from the application of rotten dung. In this case the previous reduction of the fibre of the straw is not requisite; for the moisture of such soils is sufficient to effect this by degrees, and whilst the process of growth is going on. The authority of Miller may be adduced on this subject; in his 'Gardener's Dictionary,' he observes: "In very cold moist land, I have frequently seen new horse-dung buried as it came from the stables, and always observed that the crops have succeeded better than where the ground was dressed with very rotten dung."

On the other hand, dung that has been moderately fermented, and frequently turned over, so as to be easily cut with a spade, is the most proper for such trees as require manure, or for slow-growing crops, where the roots have to remain for years in contact with it. With regard to trees and many perennial plants, no more injury would be incurred by using fresh dung instead of rotten, for the first season, or rather whilst vegetation continued active; but after the roots become nearly dormant, canker or disease of some sort is apt to ensue. The roots may have grown luxuriantly

during the summer; but when they are arrested by the approach of winter, decomposition will still be going on amongst the materials on which they feed, and these materials may perhaps be chemically changed, before the roots are again called to action.

These remarks relate chiefly to the description of manure which is most generally used. Other substances, which are or may be successfully applied to promote the growth of vegetation, are exceedingly numerous. [MANURE.]

Animal substances are very powerful manures, and require to be attenuated or diluted before plants can derive nourishment from them, or in fact before either roots or tops can be safely brought within their contact. If the roots of a plant be wholly immersed in oil or in blood, that plant will be destroyed. Blood is one of those liquid manures which is occasionally supplied to plants so situated as to render bulky manure inapplicable; but it should unquestionably be copiously diluted with water, and be allowed to rot in compost. Bones are another form of animal matter much employed, and of considerable energy, especially in calcareous soils, provided they are reduced into small fragments and fermented before being used. Gardeners often use them in that state; and now, as dissolved in sulphuric acid, they are, of course, as available in the garden as in the field.

The liquid portions of excrementitious manure likewise require either to be diluted with water or to receive an admixture of soil before they are brought in contact with the roots of plants. In the case of trees with roots lying deep in the ground, such dilution is not always necessary; but, generally speaking, adherence to the rule is advisable.

Flesh, or the carcasses of dead animals, should be chopped up and covered and mixed with many times their bulk of soil and with some lime. This, when turned over, will still form a very strong manure, and for some plants much too strong; but for such as the vine it will form a valuable compost, particularly if broken bones are added to it.

Manures derived from the vegetable kingdom require little preparation if they consist of succulent plants; their substance is easily soluble, and they may therefore be turned fresh into the soil. The period of their growth, when this is most beneficially performed, is before they run to seed. Weeds may even be used with great advantage, if properly prepared; but bad consequences may result from their seeds rendering the ground foul, and thus occasioning much expenditure of labour to extirpate them again. Seeds, it is well known, will not germinate without air; but with this, and sufficient heat and moisture, nothing can prevent them from germinating. Therefore, if weeds be thrown into a heap and turned, whilst at the same time fermentation is encouraged, till the heat is fully equal to that which would naturally cause the germination of the seeds, taking care that the outside be turned into the centre, no danger will arise from using such manure after the process has been continued sufficiently long for the germination of the slowest vegetating seeds which the heap may contain, because under these circumstances the young plants will be continually perishing as the heap is turned over from week to week. There are many aquatic plants that will not grow on dry ground, and a preparation similar to the above is not essential for the purpose of killing their seeds before their application to dry ground, which is not, so to speak, their proper element.

Woody fibre, unfermented, is useless as a manure; and tanner's spent bark, a substance very absorbent and retentive of moisture, is not capable of affording nourishment, until tannin is got rid of by fermentation, when plants, as may be observed in bark-beds, root very readily in tan. Inert peaty matter is a substance of the same kind, and will remain for years exposed to air and water without

undergoing change. When peat becomes inert, it is in vain to attempt to grow any sort of plant in it; but nothing is more certain than that if drained of stagnant moisture and mixed with lime and dung, it will become very fertile for most crops. It often happens that peat or *bog-mould*, frequently procured at a great expense for American plants, becomes inert; in such cases, a good result would be obtained by turning out the peat and mixing it up in a heap with a quantity of leaves or fresh litter sufficient to promote a moderate degree of fermentation; then, as in the case of tan, it will afford nourishment, and will, from a state of uselessness, become valuable.

Of mineral manures, *lime* is the most useful. It is not recommended for soils that contain a large proportion of soluble vegetable matter; but it produces excellent effects in such as abound in inert vegetable fibre. Gypsum, which is found in the ashes of grasses, proves a manure for lawns.

Common salt is sometimes employed in minute portions: especially in combination with vegetable matter, in the instance of sea-weeds, in which case it is found of good quality for fruit-trees and kitchen-garden crops; but vegetable life is certainly destroyed by it, if applied in any considerable quantity. Exceptions may be noticed in the case of marine plants; the samphire for example, requires it when cultivated in inland districts; and this is also true of the vegetable inhabitants of the great salt plains of Asia. Wood-ashes, which consist principally of vegetable alkali, united to carbonic acid, are a good manure, but of short duration, and they leave peaty soil in a worse state than before their application. The application of dung and lime, of composts of clay, marl, scourings of ditches, &c., would render peat *permanently* fertile, more especially when draining is judiciously attended to.—*English Cyclopædia*

Bones.

Bones have long been extrensively used as manure, especially on poor and dry sands and gravels.

Experiments on bones as a manure were made long before their use was extensively adopted, and these, in general, were not attended with a very favourable result, in consequence of the bones not being broken into sufficiently small pieces, or being put upon the land in too fresh a state. But since mills have been erected to crush them to a small size, and the proper use of them has been ascertained, the advantage of this manure in distant and uncultivated spots, where the carriage of common stable or yard manure would have been too expensive, and where it could not be made for want of food for cattle is incalculable. By means of bones, large tracts of barren sands and heaths have been converted into fertile fields.

The bruising or grinding of bones soon became a distinct business. They were broken into different sizes, accordingly called *inch bones, half inch bones*, and *dust*. Most of the bones procured from London and the manufacturing towns have undergone the process of boiling, by which the oil and a great part of the gelatine which they contain have been extracted. The bones imported from South America have been burned, and are properly bone-ash, the mineral part alone remaining.

At first sight we should be led to imagine, that having lost much of the rich animal matter which they contained, they would be proportionably less effective in the soil. This however does not seem to be the case from the comparative experiments made with bones which have been subjected to either burning or boiling, and those which are quite fresh. All those who have used bones extensively report that little difference can be observed between them; some even give the preference to those from which the glue has been extracted. But glue forms excellent manure. How is this to be explained? It appears, from the result of many experiments, that bones do not furnish much nourishment to the roots of plants until they have undergone a certain degree of decomposition. The fat and the gelatine, being intimately blended with the bony matter, and contained in cavities or cells, may remain a long time in the earth without decomposition. As a proof of this, it has been found that bones which had lain in the earth for many centuries, on spots where ancient battles were fought, afforded, on analysis, nearly as much gelatinous matter by the abstraction of the earthy parts, as

fresh bones would have done. Bones analysed by Fourcroy and Vauquelin were found to consist of—

	Parts.
Solid cartilage, gelatine, and oil ...	51
Phosphate of lime	37·7
Carbonate of lime	10
Phosphate of magnesia	1·3
	100·0

The more recent analyses of the bones of the sheep and ox by Berzelius and others are as follow:—

	Thomson.		Berzelius.
	Ileum of Sheep.	Ileum of Ox.	Bones of Ox.
Organic matter (combustible) ...	43·3	48·5	33·3
Phosphate of lime	50·6	45·2	55·45
Carbonate of lime	4·5	6·1	3 85
			Phosphate of Magnesia.
Magnesia ...	0.9	0·2	2·05
Soda salts ...	0·3	0·2	2·45
Potash ...	0·2	0·1	......
Fluoride of calcium ...	...	...	2·90
	99·8	100·3	100·00

It is obvious from these that bones must vary greatly, according to their age and other circumstances.

It would seem, then, that the great effect of bones, as a manure, must depend on the phosphate of lime; and the effect of bone-ashes seems to strengthen this opinion. As to the boiled bones, the more the bone has undergone fermentation, the more soluble its gelatine will be. In its fresh state it is only soluble in very warm water, and the oil repels moisture. This accounts for the seeming anomaly of the superiority of boiled bones; they have undergone a fermentation. The residue, although not deprived of all its animal matter, is much more porous, and will imbibe and retain moisture in its pores. The food of the plants is here ready prepared and dissolved, and kept in store without being in danger of being washed through a porous soil or evaporated by the heat. All parts of the bone contribute ultimately to the fertility of the soil. Its gelatinous and fatty parts, though a protection to the bone against the destructive action of air and rain-water, are themselves ultimately liable to decomposition, and yield by that process soluble products available for the food of plants. It is in this fact that the value of even fresh bones as manure lies. The explanation of the greater value of bones boiled and even burned, and of bones reduced to powder for manure, lies in the fact that this gelatinous and fatty envelope, though shortly becoming utlised itself, is in the meantime a hindrance to the action of those atmospheric solvents which would reduce the mineral part of the bone to a soluble condition.

It is ascertained that the effect of bones on the crop is much increased when they have been previously mixed in heaps, with ashes, burnt clay, or light loam, or made into a compost with the dung of animals, and with vegetable subtances. In this case, the fresh bones will evidently be much more advantageous than those which have been boiled; for the fermentation will extract and decompose the oil and a great part of the gelatine, which, mixed with the other ingredients of the compost, will much enrich them; while the bony residue will be in the same state as it would have been if the bones had come from the boiling-house.

While the gelatinous part of bone undoubtedly yields by its decomposition valuable fertilising substances, it is to the mineral part of the material—the phosphate of lime, or rather its phosphoric acid, which it contains—that its fertilising action is mainly due. Every process, therefore, which has increased either the solubility or the liability to solution of this part of the manure, has increased the rapidity and immediate effect of its application. By reducing bones to powder you increase their liability to solution, for you thereby increase the surface wetted by the rain-water. Rain-water contains carbonic acid, and by this acid the phosphate of lime acquires a soluble form, and is ultimately presented liquid to the absorbent roots of plants.

But this solubility can be conferred upon it directly. It was Baron Liebig who suggested that a similar process to that by which soluble phosphoric acid is obtained from bones in the process of manufacturing phosphorus, might be available in the manufacture of a valuable manure. If sulphuric acid be added to bone-dust, the latter becomes to some extent decomposed. A portion of its lime is taken from the phosphate of lime in the bone, and unites with the sulphuric acid; the phosphoric acid of that portion of the phosphate which has been decomposed, unites with the portion of phosphate which has been left undisturbed, and forms a superphosphate; and this is soluble in water. It is the proportion of the resultant manure which is thus rendered soluble that is the measure of the immediate energy and value of the so-called "superphosphate," which is thus prepared for sale and use. Every manure-maker now prepares a superphosphate—and a good manure of the kind should contain at least 15 per cent. or more of the soluble superphosphate, and 15 per cent. of the neutral, or natural bone phosphate, together with a small proportion of ammonia, resulting from the gelatinous part of the bone-dust. Where the *mineral* phosphate of lime, coprolite, or apatite, is used in the manufacture, the neutral phosphate left unacted on by the acid is useless as a manure. Where bone-dust is the source employed of the phosphate of lime, then of course, that portion left enacted on, retaining its natural

cellular structure, is still liable to the natural influence of atmospheric solvents, and will continue gradually to dissolve and yield food for plants. In both cases, however, it is the quantity already reduced to a soluble state, which is the measure of the immediate value of the fertiliser. This effect is not due to any power which the manure has thus acquired of at once entering the roots of plants, because the immediate effect of the contact of a soluble superphosphate with the earths present in the soil, is to cause it to resume its original condition of neutral, and therefore comparatively insoluble phosphate of lime. Having, however, once been in a state of solution, it retains in its precipitated state, a condition of so much finer division than any mechanical means could give it, that the superphosphate is as rapid in its action on the crops to which it is applied, as if it retained its solubility throughout.

A good superphosphate as now manufactured ought to contain 18 to 20 per cent. of the soluble phosphate, and 10 to 15 of the neutral phosphate, and from 1½ to 2 per cent. of ammonia.—*English Cyclopædia.*

Paring and Burning.

This operation consists in cutting a thin slice from the surface of land which is overgrown with grass, heath, fern, or any other plants which form a sward by the matting together of their roots. The sods are allowed to dry in the sun to a certain degree, after which they are arranged in heaps, and burnt slowly, without flame or violent heat. The result is a mixture of burnt earth, charred vegetable fibre, and the ashes of that part which is entirely consumed.

The object of this operation is two-fold; first, to kill insects and destroy useless or noxious weeds completely; and, secondly, to obtain a powerful manure, impregnated with alkaline salts and carbonaceous matter, which experience has shown to be a very powerful promoter of vegetation.

Paring and burning the surface is an almost invariable preliminary in the converting of waste lands to tillage; and where these lands are in a state of nature, overrun with wild plants which cannot be easily brought to decay by simply burying them in the ground, burning is the readiest and most effectual mode of destroying them. In this case the practice is universally recommended and approved of.

But it is not only in the reclaiming of waste lands, and bringing them into cultivation, that paring and burning the surface is practised. The fertility produced by the ashes, which is proved by the luxuriance of the vegetation in the first crop, has induced many to repeat this process so often, as materially to exhaust the soil, and induce partial sterility. Hence the practice has been recommended on the one hand, and strongly reprobated on the other.

When we come to apply to the subject the test of experience, and reason correctly on the facts which are presented to us by the abettors of the practice and its adversaries, we shall find that the advantages and disadvantages arise chiefly from the circumstances under which the operation is carried on. But it may be necessary to an impartial examination of the subject, to inquire into the changes produced on the substances subjected to the process of burning, when it is done with due precautions.

In burning vegetable matter in an open fire, the whole of the carbon is converted into carbonic acid and flies off, leaving only some light ashes containing the earthy matter and the salts which the fire could not dissipate. These are no doubt very powerful agents in promoting vegetation, when they are added to any soil; but they are obtained at a very great expense of vegetable matter, which by its decomposition in the earth might also have afforded food for vegetation. If the earth which is burnt with the sods is of a cold clayey nature, the fire will change it into a kind of sand, or brick dust, which is insoluble in water, and corrects the too great tenacity of clays, by converting them more or less into loams. This is so well known, that clay is often dug out of the subsoil to be partially burnt. But in addition to the many mechanical effects of heat on clay, there are certain chemical results of great advantage to fertility. When not burned to excess the alkaline ingredients of clays become more soluble when they are exposed to heat, and no doubt some of the beneficial effects of clay burning are due to the greater quantity of soluble alkaline matter which is then made available: and on stiff clay soils therefore there is a double advantage in paring and burning that of the vegetable ashes and of the burnt clay.

Burning clay soils is in fact something analogous to liming. Lime dissolves the vegetable matter and sets free the alkalies, and it enables the detached elements to enter into new combinations; but if no new vegetable matter be added to restore what is exhausted by vegetation, liming, as well as paring and burning, is detrimental in the end. Many experienced farmers pare and burn the soil on the edges of their ditches and on the banks on which the hedges grow, because they thereby exterminate many rank weeds; and the burnt earth mixed with farmyard dung makes an admirable compost. Here the burnt earth acts as an absorbent, and no doubt attracts many of the volatile parts of the manure, which are produced by the decomposition of animal and vegetable matter in it. Paring and burning therefore

should be joined to manuring, if a powerful and immediate effect is desired without exhausting the soil; and in this case we do not hesitate to recommend it on all cold clay soils where rank weeds are apt to spring up, and coarse grasses take the place of the better sorts which have been sown. The proper time to pare and burn is evidently after the land has lain in grass for several years, and is broken up for tillage. The surface should be pared thin; about two inches is the extreme thickness allowable for the sod if the soil is very stiff and poor, and as thin as possible in a better soil. The sods should be moderately dried, and then arranged into small heaps with a hollow in the middle to hold heath or bushes to kindle the fire. When it has fairly established itself, all the apertures should be carefully closed. Wherever any fire breaks out, a fresh sod should be immediately put over it; a heap containing a small cart-load of sods should be smouldering for several days without going out, even if it rains hard. If the fire is too brisk, the earth will form hard lumps, and even vitrify; but otherwise it comes out in the form of a fine powder, in which evident marks of charcoal appear. If this is of a fine red colour, it is a good sign; for the iron in the earth has been converted into a peroxide, which is perfectly innocent in its effects on vegetation, whereas all the saline impregnations of iron are more or less hurtful. It is better to burn the sods in large than in small heaps; for the more the fire is smothered, the better the ashes.

So great a quantity of ashes is sometimes produced as to admit of a portion being carried off or used to manure another field. As this is evidently robbing the field where the operation has been carried on, an equivalent quantity of manure should be brought in exchange. Perhaps the most advantageous mode of using the ashes is to spread them in the drills where the seed is to be sown, after a portion of dung has been buried under them. In this manner the ashes from one acre of land pared and burnt, together with ten or twelve cart-loads of good dung, and a half dressing of superphosphate of lime, will manure two acres.

Lime may be used at the same time with the ashes, and will increase their effect, provided some vegetable undecayed matter remains in the soil after paring; but lime will tend to exhaust this; and if, in consequence of liming, a few good crops are obtained at first, the soil will be so exhausted as to be of little value afterwards. This is the abuse of the practice, which has caused it to come into disrepute. It would be a great waste to burn the surface of a rich piece of grass-land where the plants growing in it are tender and succulent, and would readily rot on being ploughed under; in such case a moderate application of lime would have a much better effect. This kind of land will produce good crops without any manure, and continue fertile for many years if judiciously cultivated. To pare and burn rich land is wasteful, and can never be recommended. It is only on poor land which has not strength to produce a crop, and of which the texture requires to be improved and its powers stimulated, that paring and burning is advantageous.

Many tracts of waste land might be brought into cultivation by means of paring and burning, which without it would never repay the labour required. Where the soil is inclined to peat, this operation and abundant liming are the indispensable preliminaries of cultivation. The ashes and the lime will produce vegetation and food for animals. These will produce dung to supply what the vegetation abstracts, and to assist also in the further decomposition of the peaty matter, converting it into vegetable mould.

The partial paring and burning of the headlands of fields, for the purpose of mixing the ashes and burnt earth with dung in a compost is a most excellent practice, and often superior to that of using the sods only, without burning them. These sods contain innumerable seeds of weeds, and eggs or maggots of insects, which are not destroyed by the fermentation of the heap, but on the contrary are brought to life. The loss of a portion of vegetable matter in the burning is amply compensated by the destruction of these enemies of the future crops.

It now only remains to take notice of the soils and situations where paring and burning cannot be recommended. Wherever the soil is very loose from a great proportion of silicious sand in its composition, and is held together chiefly by the slender roots which run through it, the burning would destroy the whole of the vegetable matter; and the residue would be a mere barren silicious sand, much worse and more porous than it was when held together by the roots. The only way to bring such soils into cultivation is to put clay or marl on them, and to force vegetation by means of liquid and other manures, consolidating them by every means applicable, so that they may retain moisture, and that the manure may not be washed through by the rains. Such soils may be improved, but they are the most ungrateful of any; and it is only necessity and indefatigable industry which can make them produce any crops.

On the whole, the operation of paring and burning, when judiciously applied and properly performed, is a most excellent and cheap improvement of dry soils, and it will never diminish their fertility, if they are properly cultivated and manured, but on the contrary it will improve their quality and texture, and make them more productive.—*English Cyclopædia.*

On the Necessity for the Introduction of Artificial Manuring in Tea Cultivation.

By Charles E. M. Russell, M.R.A.C.

Agricultural chemistry is as yet but in its infancy; it is, however, a giant infant, and one which since its birth has been growing with remarkable rapidity, and evermore indisputably asserting its importance.

As in the case of all infant sciences, its nurture has not been entirely free from errors of conception, and consequently of management, on the part of its foster parents; but the present century, which is now approaching an honorable close, has raised up for it many and able guardians, who have detected and rectified the mistakes of their predecessors, and, at the same time, have not failed to profit by their experience and its deductions, wherever the latter have been proved to be sound.

Into such a brief space as I must necessarily condense this article, it would be impossible to give any adequate account of the rise and progress of agricultural chemistry, and I, therefore, propose to confine myself to an outline of the leading facts bearing upon the ordinary routine of planting, which have, by its assistance, been brought to light.

All planters are aware that the plant is anchored in the soil, and that by its roots it withdraws from thence the nutriment essential to its growth and development; few however are able fully to appreciate the character of such nutriment, the extent of its natural supply in the soil, and the intricate processes by which the insoluble portions are rendered available for absorption by the roots; and hence we often see men, who are otherwise good and thoroughly practical planters, meeting with severe reverses through their inability to comprehend and to cope with the great question of plant-food.

A vegetable is composed—as indeed are all organisms—of two great classes of constituents; namely, the *volatile*, or those eliminated by combustion; and the *ash*, or mineral, which remain after total ignition. A portion of the volatile, as well as the whole of the ash constituents, being derived from the soil, it is highly important, and indeed absolutely essential, that it should contain sufficient of them to afford an ample supply of food for the plants for whose sake it is cultivated. In the case of land continually under crop and unmanured, there must be some limit to the supply it can yield, for in the portion of the crop which we remove, we take away from the soil an amount of the available ash constituents, which in time tends seriously to impoverish it. We cannot, therefore, consider the soil as a mine of vast and inexhaustible riches: and by *the soil*, in this instance, I mean such part of it as is available to the roots of the plants; so if we wish it to retain its pristine fertility, we must return to it in another form, the valuable potash, phosphorus, and nitrogen, which are contained in the crops which we are incessantly removing.

Take, for instance, the case of a tea-garden of say twenty years' standing, and calculate the amount of valuable mineral matter which has been removed from the soil in the leaf which has been plucked during this period. Let us suppose that the soil was originally one of great natural fertility, and let us estimate the yield per annum at five maunds per acre. The total amount of tea made will thus be $5 \times 20 = 100$ maunds per acre in the twenty years. Now since the amount of ash in Black tea (as found by Professor Wolff and Knop) reaches 6 per cent., we can easily see that for every 100 maunds of tea, the soil is impoverished to the extent of 6 maunds for the mineral portion alone of the leaf removed. On some gardens where proper attention is not paid to the management, large quantities of the prunings of the bushes are removed by the coolies for use as fuel, thus rendering the drain upon the land

perfectly ruinous to its permanent fertility: on other estates where seed is gathered as well as leaf, the exhaustive process goes on with wonderful rapidity; for it must be borne in mind that at the time of the gathering of the seed, all the most valuable mineral matter which has been collected by the plant, will be found stored up in its cotyledons and embryo.

The soil we must regard as a complex mixture of a very large amount of mineral matter, which can never be of any use to plants (further than that it affords them an anchorage,) together with a small amount of actual plant-food, some of which is at once available for absorption by the roots of vegetation, while by far the greater part exists in an insoluble condition, requiring time, and the various operations of Nature, to render it of any service to the plant: and when we consider that after all the real amount of plant-food in the soil is so very limited that some very fertile sands contain when dry 85 per cent. of silica, which is utterly useless both now and for ever as a plant-food, and that much of the real manurial matter, such as lime and soda, exists in larger proportions than are absolutely essential to plant nutrition, while the most useful constituents, which we are so constantly removing in large quantities, exist but in very small proportions in the soil, we shall, I feel assured, be compelled to admit the necessity of manuring in the cultivation of tea.

There is then a point at which the natural wealth of that portion of the soil accessible to the roots of the tea-plant will fail us; and few planters, in districts where tea has been long under cultivation, need go far to find gardens the yield of which is annually decreasing through exhaustion of the food essential to the growth and production of the leaves of the tea-bushes.

Let us now briefly consider the elements which compose both the ash, and also the volatile portion of every vegetable.

The elements which are set free and escape into the air on burning the plant, are, *Carbon*, *Hydrogen*, *Nitrogen*, and *Oxygen*, with perhaps a little *Sulphur* and *Phosphorus*. Of these elements carbon, sulphur, and phosphorus, while in their free or uncombined state, are all solids; hydrogen, oxygen, and nitrogen being gases: two of the latter, namely, oxygen and nitrogen together with a little water vapour and a small quantity of a gas called *carbon-dioxide* (a compound of carbon with oxygen) forming the principal portion of the air which we breathe. Other gases are present in the atmosphere, but their quantity is so inconsiderable, and the part which all but one plays in the function of vegetable nutrition so unimportant, that I shall here only mention the important one, which is *Ammonia*.

The gas mentioned above, *viz.* carbon-dioxide, is essential to the formation of the vegetable structure, as it supplies to the plant the *Carbon* which forms so considerable a portion of its total weight. By the '*Stomata*' or mouths, distributed over the surface of their leaves—chiefly upon the under-side,—plants absorb this carbon-dioxide, which is formed in large quantities by the respiration of animals, and when organic matter decays, or is burnt, in air; and decomposing it by virtue of their *Chlorophyll* or green-colouring matter, they retain and store up the *Carbon* in their structure, and eliminate the *Oxygen*, thus purifying the air which is defiled by the breath of animals. *Iron* being essential to the formation of chlorophyll, without iron this action cannot take place; and therefore, without it, the higher orders of plants are unable to exist.

Of the other elements which are lost upon burning, *Nitrogen* is the most important. We have already considered the method in which the plant assimilates its *Carbon*, as well as the source whence it is chiefly derived: let us now briefly refer to that other all-important gaseous element, *viz.*, *Nitrogen*.

During thunderstorms, the electrical disturbance of the atmosphere causes a small amount of its nitrogen to unite with hydrogen, in the proportion of one part of the former to three of the latter, thus forming the compound which we call *Ammonia*. *Nitric Acid* is, under the same atmospheric disturbances, generated by the coalition of nitrogen with oxygen,—one part of the former to three of the latter being requisite to form this compound gas: now the rain-water, having dissolved these gases, carries them down with it into the soil which, by its absorptive properties, catches and retains them, uniting the nitric acid with its solid elements so as to form fixed compounds called *Nitrates* and *Nitrites* of soda, potash, etc.; while the ammonia is partly united with gaseous elements, as chlorine to form solid *Ammonia-salts*, and partly remains entangled between the ultimate particles of the soil, which can, while in a fine state of division, perform a function similar, though in a far less degree, to that exhibited by charcoal in the absorption and condensation of gases.

The ash constituents are very varied and numerous; many of them appear to be never totally absent, and yet we cannot prove them to be essential: we may however safely adopt Professor Johnson's view of the case, and conclude that *Sodium*, *Chlorine*, and *Silicon*, though never totally absent, if at all indispensable, are requisite in but a minute quantity for the requirements of ordinary crops,—an exception in the case of plants of a maritime origin occurring in the favor of chlorine, which is by such a class required in larger quantity for their full and healthy development.

Iron we have already proved to be quite indispensable.

Potassium, *Calcium*, *Magnesium*, and *Sulphur* are all essential; of these, the two last occur partly in the ash, and partly in the portion eliminated by combustion. The elements *Iron*, *Calcium*, and *Magnesium* are usually present in more or less soluble salts in quite sufficient quantity in most soils; but the very important *Phosphorus* and *Potassium* are not nearly so abundant in natural soils; and therefore as each succeeding crop is annually exerting a great drain upon the limited supply of both these elements, and also of the very important nitrogen mentioned above, and as the area accessible to the roots of the tea plants is but small, we must either return to the land in manure some part of the wealth of which we have robbed it, or be prepared to find,—what must inevitably be the case after a certain time,—that our land is annually decreasing in fertility, till we begin at last, though too late, to realize the fact that a limit may be reached at which it will be but vain to expect any yield whatever: though happily such a consummation would not be effected under a great lapse of time,—so generous a provider is Nature!

The means by which we can most efficiently and economically supply those constituents which are most essential to plant-growth, and whose supply in the soil is so limited, should be determined by a well-planned series of experiments.

In a large town, such as Calcutta, considerable quantities of valuable manures, such as the waste of various manufactures, could be very cheaply obtained. Blood, mixed with sawdust, which has been soaked in sulphuric acid, is a most valuable fertilizer: bones, the refuse of hides, horn, hoofs, etc., or others which, with vegetable wastes, such as oil-cakes, would be well worth the planter's while to secure, provided he had not to pay a heavy freight for conveying them to the tea-garden. The high rates charged by the Steamer Companies from Calcutta prove a most serious impediment to the importation from thence of any manures whatever, and nothing but co-operation among the planters can be brought to bear upon the question with any hope of reducing the magnitude of this difficulty. Numbers of other valuable manures might be mentioned; but their great price, even in Calcutta, seems to pre-

clude the possibility of their ever becoming of general use in tea cultivation, until at least experiment has proved that their employment can pay, and pay handsomely, in spite of their original cost.

To the solution of so great a question as the one which we are at present considering, the co-operation of all planters of intelligent and liberal views—more especially upon poor and exhausted soils?—is necessary: let each one try, say, one or two inexpensive experiments upon a small scale, and lay his results before the rest through the medium of this paper. In so doing let him state the locality in which he may be situated; the character of the soil experimented upon; the manures employed in his experiments, and their quantity per acre; the amount of tea, in maunds, which the manured portion has yielded in the season, as well as the increase in yield by such manure over the average (if an old garden) of the two or three seasons previous to that in which the experiment is tried. These facts, when accompanied by the age of the garden, and the distance at which the bushes are planted, the cost of purchasing, carrying, and applying the manure, and the extent of the probable supply obtainable for the future, will, when set against the increased return in money-value per acre, give us a very fair idea as to its practicability or the reverse. To make the experiment perfect, an analysis of a sample of the soil, taken at the depth of eighteen inches, should be obtained and published with the results.

Some portions of the Indian tea districts have now been long under cultivation; and in the history of every agricultural country in which land has become too valuable to relinquish, when exhausted or impoverished by frequent cropping, there comes at last a time when we are obliged to call in science to our aid, if we wish to render its further cultivation in the least degree profitable; and to many tea gardens that day has already come. Let us then all co-operate in giving each other the benefit of our own individual experiences: and we cannot fail, one and all, to profit by the deductions which we shall draw therefrom.

BLOOD MANURE.

By C. E. R. Russell, M.R.A.C.

How to prepare blood for manure so as to fit it for storing in large quantities without fear of its suffering decomposition. The best plan would, I think, be the following:—

(1.) Having allowed the blood to ferment in a vat, add lime, and pass a jet of steam through the mixture: ammonia gas will be liberated; and if this gas be passed over trays containing sawdust saturated with sulphuric acid, it will combine with the sulphuric acid to form the extremely valuable manurial salt termed sulphate of ammonia, or in chemical parlance, ammonium sulphate (N. H4) 2 SO4.

(2.) The potash and nitrogen contained in the residue remaining in the vat will, if this residue be composted with lime, render the product a valuable manure, which can be easily stored.

Process No. 1 is that adopted in England in the manufacture of sulphate of ammonia from gas water. In the purification also of coal gas, the passage of the gas over trays of sawdust and. sulphuric acid removes the ammonia contained in it as an impurity, and forms sulphate of ammonia of the (in this case) waste product after its combination with the acid.

Sulphate of ammonia is an extremely valuable salt: samples containing 25 per cent., or one quarter of their total weight of ammonia, are valued at £20 per ton. Hence ammonia

pure is supposititiously calculated as possessing a market value of £80.

Regarding the treatment of blood *with a view to its storage in considerable quantities* without fear of undesirable consequences, I recommended the fixing of the contained ammonia by sulphuric acid on the one hand, and the formation of a compost with lime from the residue on the other.

A highly nitrogenous manure such as blood should be applied but very sparingly, and in combination with a good permanent mineral manure, or rather a manure whose efficiency depends upon its mineral constituents, otherwise, if this be neglected, the plants will be stimulated to such an extent by the nitrogen as to enable them to withdraw from the soil within reach of their root so large a proportion of the contained soluble mineral plant-food as to exhaust it for the time being, and plants thus unduly stimulated, while showing extraordinary vigour for a short time, would soon die of starvation induced by their own hyperstimulations. A bodily strong man compelled to constant brain-work would soon lose health were he to carefully avoid all food in which the element *phosphorus* occurs; a man suffering from lock-jaw may be kept alive for a few days on brandy or upon port-wine, but unless followed up by nitrogenous and carbonaceous foods, the stimulant will soon cease to afford its fictitious strength when the natural waste of muscular tissue and of the heat and fuel-affording hydro-carbons is no longer made good as it is in health by the use of food containing these indispensables: so it is with plants; you can stimulate them by nitrogenous food, only so far as you can afford them the extra amount of mineral matter which their increased growth will require: the balance must be retained; and once you have increased the stature and vigour of a plant by the use of manure, you must either keep it up by regular application of necessary food, or else suffer it to relapse from a giant into a dwarf—possibly at the sacrifice of its life. I do not mean to say that blood contains no mineral manurial matter, for its analysis shows, in *dried* blood from the ox, a percentage of some 4·4 per cent. of valuable ash constituents; still, the nitrogenous elements preponderate, and require dilution and backing up with strong permanent mineral plant-food.

The whole question of tea manures is one requiring some years of careful and elaborate experiment and analysis to solve: proportions and intervals of application cannot be laid down at random from a cursory glance at the analysis of the ash of the plant.

To use blood comparatively fresh, I should advise digging under cover trenches—say 3 feet deep, place at the bottom a layer six inches deep of half-burnt clay; upon this a layer six inches deep of crushed oil-cake saturated with blood, alternating the layers of half-burnt clay and crushed oil-cake and blood until the pit is full; upon the top place a layer one foot deep of half-burnt clay and charcoal covered by say two or three inches of clay; any gas,—ammonia or ether—which may be evolved, will be absorbed by the charcoal and burnt clay, as will any effluent liquid be caught by the bottom layer, and the mass if allowed to decompose will, when mixed with an equal bulk of cow-dung and half its bulk of crushed or half inch bones, form a rich and considerably permanent manure. The amount which should be applied to each mature bush, and the period at which the manure will require renewing, can only be ascertained by careful and accurate experiment during some years.

MINERAL MANURES.

In a recent number we promised to refer again more fully to the question of the use of *copperas* as a manure, and we now do so. The subject may be best treated by a general discussion of the nature and

properties of, and necessities for, mineral manures.

Pure mineral manures besides being expensive, are (if we except lime) not, as a rule, in much favour. And even lime is not recommended for soils that contain a large proportion of soluble vegetable matter. But lime, besides being itself a plant food, is intermediate in texture between clay and sand, and therefore useful in improving the *mechanical* character of either. Its chemical actions are manifold, and it is a most useful preparer of plant food by oxidation. In England, where high farming prevails, liming is one of the operations looked upon as indispensable, and is allowed for on a change of tenancy as a permanent (till the end of the seventh year) improvement.

The nitrates of soda and potash are frequently applied on poor lands, but they should never be applied to a perennial crop, unless in small quantity, and backed up by a good permanent gradually-yielding manure such as crushed bones: were the latter point neglected, the nitrogen would stimulate the plant to such an extent at first as to render it capable of exhausting the soil of the soluble mineral constituents within its reach, and it would ere long die of starvation. It must be borne in mind, that nitrate of soda and nitrate of potash are not held by the soil, they must be taken up at once, or they are washed through the soil and lost.

Tea soils in this country are not deficient of iron in their composition. Therefore, broadly speaking, it may be said that copperas would be useless. Most soils contain quite sufficient iron for the use of any crop, but in case where deficiency might be suspected, an analysis of the soil would at once decide the question. We have never known iron to be applied in any form in England. Some soils contain too much iron in the form of the lower oxides, which are very soluble, and therefore very poisonous, but copperas would be decidedly the least harmful on account of its comparative insolubility. In cases of soils poisoned by the presence of the lower oxides, further oxidation may be effected by breaking up and exposing the soil to the atmosphere, and also by liming, and the soluble protoxide changed into the almost insoluble copperas. Notwithstanding the fact that iron is essential to plant life, *i.e.*, the higher forms of plant life, so abundantly is this element distributed throughout nature that its application is never necessary, could do no good, and might, if applied in a soluble form, (for in excess it acts as a plant poison) do great harm. The comparative insolubility of copperas would prevent the iron being absorbed by the plants in more than minute degrees, and on this account only would it not act as a poison. An analysis of the most fertile tea soil known, an analysis of raw plucked leaf, and a few calculations, would show us exactly the constituents and the quantity per acre which we should have annually to apply to prevent the soil ever losing a fraction of its fertility.

Salts of *potassium, phosphorus, and nitrogen*, are the mineral constituents which are apt to be exhausted by frequent cropping. Occasionally where a special crop has been exerting a call upon some special constituent affected by itself, others, such as *magnesium* and *sulphur*, may be too largely removed. The amount of the salts of potassium, phosphorus, and nitrogen, present in the soil is very small, and the call upon them very great indeed.

Mineral matter, as we know, does not exist in the atmosphere, and such proportion, therefore, as a plant requires, must be obtained from the soil. But the thing is to determine what proportion the soil lacks, and this can only be determined by analysis.

The only reason for the application of mineral manure to the tea bush would be, perhaps, that the manure of the grass-fed cow, which is what is most generally used, does not contain a sufficiency of mineral matters. But the agricultural value of a manure is, it must be remembered, greatly increased by its solubility and its fine

state of division, permitting prompt assimilation with the soil. In this respect copperas could not be used with advantage in its crude state. Whether, if amalgamated with any other substance which would absorb it, and applied thus in a mixed and soluble form, it would affect the flavour of the tea, we cannot say, but should incline to the belief that it might: it would be worth while making the experiment on a few bushes, and watching the result.

As we have said, the true secret of the value of manures is in relation to the special requirements of the particular soil, *i.e.*, the supplying those constituents which it lacks. A man to be a successful agriculturist, (by the term agriculturist of course we include the tea planter), should possess a knowledge of soils and their mode of analysis. Too little attention, we fear, is paid to this subject, and planters would do well to devote some of their leisure more generally to the study of practical chemistry as affecting soils. They would then be able to combine theory with practice, and to find the acceptable mean of the former. The scientific man is too often wedded to mere theory; the practical or unscientific man too often despises theory altogether. What is wanted is the requisite proportion of both. The best and simplest practical analytical work that we know of is a little Book called Church's Laboratory Guide, and we would recommend every planter to provide himself with it. Professor Johnston's Handbook on the Analysis of Soils goes further into the subject, but is hardly suited to a beginner.

A thoroughly fertile English soil analyzed was found to contain the following:—

1	Silica and sand ...	648·00
2	Alumina	57·00
3	Silicate of alumina	Carbonic acid.
4	" magnesia	40·00
5	Organic matters ...	97·00
6	Carbonate of magnesia ...	8·50
7	Carbonate of lime ...	59·00
8	Sulphate of lime ...	2·00
9	Phosphate of lime and magnesia	4·50
10	Potash salts	2·00
11	Soda salts	6·00
12	Carbonate of iron or oxides	61·00
13	Manganese and iodine ...	1·00
14	Loss during analysis ...	14·00

Of these constituents Nos. 4, 8, 9, 10, and 11, are as a rule found greatly deficient in Indian soils, and they require to be supplied as far as possible; but the indiscriminate use of manure is too often mere waste, because the particular ingredients necessary to constitute a fertile soil are not taken into account.

It would, we think, in the long run, pay well were a larger number of cattle kept on tea gardens for the sake of manure. Sheep and goat droppings—especially in the matter of sheep—are most valuable, but sufficient care must be taken to collect the manure, and keep it under cover—a precaution much neglected.

Of all natural manures none is so complete, *i.e.*, so general a fertilizer, as that formed from the mixture of the dung of all the farm flocks: cattle dung is very dilute, horse dung very hot, sheep dung very concentrated and rich, and pigs' dung very rich: the whole mixed, and carefully stored where rain cannot fall upon it, and where it is not too much exposed to the atmosphere to lose by evolution of gases from a large surface, forms the best and most easily assimilated fertilizer.

The difficulty in the hills is that a sufficiency of grass land is seldom obtainable; but it must be borne in mind that the manure of the stall-fed animal is so much richer in essential properties than that of grass-fed cattle that the extra expense is fully compensated for in the character of the yield obtainable; and where *bhoota* is so easily culturable, the difficulty as regards insufficiency of pasturage may, in many cases, be readily and even advantageously overcome.—*Indian Tea Gazette.*

A CONTEMPORARY took occasion a few weeks ago to comment upon the "non-scientific" treatment of the above article on

mineral manures. Regarding the criticism we would make the following remarks :—

Copperas is practically insoluble in water. In the *Indian Tea Gazette* of December 4th, its employment was proved to be useless, and was not advocated, and the question would never have been mooted at all except in answer to a direct enquiry regarding it from a correspondent. Copperas was stated to be less prejudicial to plant life on account of its comparative insolubility than are the low oxides of iron, which are very soluble, and therefore poisonous to vegetable life.

A *Salt* is a solid combination of a basic, with an acid or non-metallic element. The salts are referred to the basic, and not to the acid element: hence the term "*Salts of Nitrogen and Phosphorus*" was chemically incorrect. Still from the context it must have been perfectly evident to any who read the article under notice in any other spirit than that shown by a desire to discover a fault, (or a slip of the pen that might be construed into a fault), that the meaning intended to be conveyed was—"Salts formed by the combination of the acids of phosphorus and nitrogen with bases :" the greater stress intended to be laid upon the manurial importance in combination of these two non-metallic and most valuable elements having unwittingly sacrificed strict technicality on the altars of lucidity and brevity.

In no place was nitrogen spoken of as a mineral, though natural salts formed by the combination of nitric acid with a base *are* minerals. It would be as reasonable to deny that natural iron ore (*i.e.*, the commonest form of it, *viz.*, oxide of iron) is a mineral on account of its containing oxygen, which is a gas, as it is to take exception and to cavil at the connection in which it is spoken of in the article under notice.

MANURE FOR TEA LANDS.

A "Novice in Tea," writing to the "*Englishman*," says :—

Every one interested in tea should be obliged to you for the articles and communications which have appeared in your paper relating to manure; and as you invite discussion on this very important subject, will you allow me to add a few facts in connection therewith, which I had acquired for my own guidance, and which perhaps may prove of service to some of your readers? I am not a chemist; consequently my remarks will be more practical than scientific, and no doubt occasionally inaccurate and open to criticism. I believe, however, I am not far wrong in the following particulars, *viz.* :—First, as to what soils consist of; second, as to what the plant takes out of the soil; third, what are the constituents of Indian tea leaves, manufactured tea, tea extract, spent leaves, and tea ashes; fourth, what should be done to replace the substances removed from the soil.

All soils consist of organic and inorganic bodies: the latter, the earthy and stony substances; the former, animal and vegetable matters. As a rule, soils contain but a small percentage of vegetable or other organic matter, from three to ten per cent. only,—the proportion being easily ascertained by placing a sample of soil over a strong fire, when the organic portion will be more or less readily burnt away, while the residue will represent the inorganic percentage, which is fixed and permanent in the fire.

The best soil for tea is a strong humus soil, full of organic matter, provided it be friable—that is to say, contain thirty per cent. or so of sand. Such soils, however, are scarce, and the bulk of land taken up now-a-days for tea is a light loam, containing plenty of sand, with more or less of clay, carbonate of lime, potash, magnesia, and oxide of iron; while the richer it is in organic matter the better for the growth of the plant. Clayey soils, containing little or no lime, and marly or calcareous soils, containing lime in excess, are unsuitable for tea.

Clay can, with difficulty, and only at heavy expense, be brought to grow tea; sand, on the other hand, with but moderate manuring, can be made a fair fielding soil.

The following rough analysis of soils can be undertaken by any one, as the tests employed are of the simplest. I believe the information appeared originally in a work published in Madras some years ago, but I am not certain of this. I merely copy the tests for the benefit of your readers as I find them in my note-book, and can add that I have proved them most efficient. Of course they are not scientifically exact, but do well enough for all practical purposes; and any planter can tell by their use whether the ingredients referred to are in his soil. A more accurate analysis would have to be made by an experienced chemist. The tests I refer to are as follows :—

1st.—Weigh a given portion of soil; heat it, and dry it. The loss is water.

2nd.—Burn whatever remains The loss is chiefly vegetable matter.

3rd.—Add hydrochloric acid to the residue. Thus the quantity of lime may be determined, its presence being indicated

by effervescence; and the longer it continues, the richer the soil in lime.

4th.—Wash a fresh portion of soil to determine the quantity of insoluble silicious sand.

5th.—To determine the presence of humic acid, dissolve a little common soda in water, add some of the soil thereto (previously reduced to a pulvurent form), and give it a good boil. Pour the solution into a glass and let it settle, and then pour off the coloured solution without any sediment into another glass. If vinegar, or diluted hydrochloric acid be added to the clear brown or brownish coloured liquid, brown flecks will fall, which are humic acid. 39lbs. of carbon and 27lbs. of water form 63lbs. of humic acid. All black and dark coloured soils are rich in this fertilizing substance; poor soils contain little, and sandy soils absolutely none.

6th.—To determine the presence of phosphate of lime or bone earth, weigh out 200 grains of soil and place it in a glass, pouring half an ounce of diluted hydrochloric acid over it. Stir and mix with a glass rod, and allow it to stand for thirty hours after which add half an ounce of distilled water. Stir as before, and run through filtering paper. If to this clear solution liquid ammonia be added, a pale amber-coloured liquid will float, like oil on water, on its surface. This is phosphate of lime in solution, and it may be precipitated by further additions of liquor ammonia.

7th.—For iron, treat the soil as before with the acid, and to the filtered solution add a grain or two of prussiate of potash. Stir as before, and in a few minutes the solution will become of a beautiful blue colour, owing to the presence of iron in the soil.

8th.—To ascertain the presence of nitrate of potash, or saltpetre, boil 500 grains of soil in two ounces of distilled water. When cold, run through filtering paper. Evaporate this cleared solution (over sand, or water, as most convenient) till reduced to a teaspoonful. In it dip a slip of unglazed paper (the margin of a newspaper will supply the material needed) and dry it in the sun. If nitre be present, this slip of paper on being fired will behave exactly like touch paper.

With the use then of one or two wine-glasses, a little blotting or filtering paper, and a few simple tests to be found in his medicine chest, a planter should be able to form a pretty fair estimate of his soil without troubling an analyst. Where distilled water is not procurable, good clear water, boiled and passed through a filter, will answer the purpose nearly as well.

We have now to see what the plant takes out of the soil. I have mentioned above that soils contain but a small percentage of organic matter; plants on the other hand contain much organic and little inorganic or mineral matter. This organic or combustible matter in plants is composed almost exclusively of carbon, hydrogen, oxygen, and minute portions of sulphur and phosphorus,—being in the proportion of about 50 per cent. of carbon, 38 per cent. of oxygen, 5 per cent. of hydrogen, 4 per cent. of nitrogen, 2 per cent. of sulphur—with traces of iron, phosphorus, and manganese, which elements are supplied in the way of food by the atmosphere through the leaves, and to a less extent by the soil through the roots. Thus carbon is supplied to the plant from the air in the shape of carbonic acid, and in a small proportion only from soluble compounds, such as humic and ulmic acids, existing in the soil; its hydrogen and oxygen are derived from water; its nitrogen from ammonia, nitric acid, and other soluble nitrogenous substances partly washed down by rain, from the air, and partly natural to the soil; and its sulphur and phosphorus from sulphuric and phosphoric acids. The green leaves of the plant are constantly absorbing carbonic acid and rejecting oxygen by day; they absorb oxygen and reject carbonic acid by night, retaining a considerable part of the latter as food. Decaying vegetable matter, on the other hand, rejects all its carbonic acids day and night, and that which would be food for the living plant is thrown off as poison by the dead plant. Soils containing much vegetable matter are thus full of carbonic acid, as those containing animal substances abound in ammonia.

If the Planter wishes to know what his bushes extract from the soil, it is necessary that he should be acquainted with the constituents of green tea leaves, manufactured tea, tea extract, the spent leaves, and tea ashes; and I would recommend all to procure a work by Professor Wanklyn, published by Trübner & Co. in 1874, called "Tea, Coffee, and Cocoa Analysis," which should be in the hands of every planter.

The leaves of the tea bush are all that is actually removed from the land, provided that prunings and weeds are buried, and which in every case should be returned to the soil to keep up its fertility, it being very short-sighted policy to leave them to rot on the surface. The leaves contain a large proportion of water, which is taken back by the soil from natural sources. All but about 5 per cent. of this water is driven off in the process of firing the leaf, the residue, or manufactured tea, consisting of the following substances:—

In the extract or soluble part:—

Dextrine, glucose, gum, principally carbon	...	17·55 p. cent.
Tannin	...	11·00
Theine (the alkaloid of tea, 28 per cent. of which is nitrogen)	...	2·00
Nitrogen	...	6·00
Potash	...	2·75
Ammonia	...	·70
Chlorine and Sulphuric Acid	...	a trace
Essential Oil	...	do.
		40·00 p. cent.

And in the spent leaves, of insoluble part:—

Water ...	5·00 p. cent.	
Woody fibre, principally carbon ...	27·00 ,,	
Legumen, a nitrogenous protein substance, sometimes called vegetable casein ...	15·00 ,,	
Other protein albuminous compounds ...	10·00 ,,	
Insoluble tannin and insoluble ash ...	3·00 ,,	
		60·00 p. cent.
		100·00 ,,

Tea, it will thus be observed, is extraordinarily rich in nitrogen—so much so that the fresh leaves contain more nourishing protein compounds than beans and peas; and were it possible to render the coarse leaves palatable, they might be used as a nourishing article of food.

The whole percentage of the leaf need not necessarily be returned to the soil, as we have already seen that part of it is derived from the air. To determine approximately the substances actually extracted, and which cannot be restored from natural sources, we must pay attention to the ash of manufactured tea, the analysis of which is given by Wanklyn as follows:—

Potash ...	3·00 p. cent
Soda ...	·10
Magnesia ...	·30
Lime ...	·25
Oxide of Iron ...	·25
Protoxide of Manganese ...	·05
Phosphoric Acid ...	·80
Sulphuric Acid ...	a trace.
Chlorine ...	do.
Silica ...	·25
Carbonic Acid ...	1·00
	6·00 ,,

While the combustible or gaseous portions of the manufactured leaf are:—

Water ...	5·00 p. cent.
Nitrogen in the tea extract ..	6·00
,, ,, ,, insoluble spent leaf	6·00
,, ,, ,, Theine ...	·50
Carbon ...	40·00
Oxygen ...	3·00
Hydrogen ...	5·00
Sulphur ...	1·50
	94·00
	100·00 ,,

The bulk of the carbon, oxygen, and hydrogen of the above being supplied by the air, and existing so plentifully in good tea soils, and the quantity of soda, magnesia, lime, oxide of iron, and manganese extracted being comparatively insignificant, we need only pay attention to a re-supply of the other substances,—nitrogen, potash, sulphur, and phosphoric acid, the two former, nitrogen and potash, being those of most importance. These being 12½lbs. of the former and 3lbs. of the latter in each 100lbs., it therefore follows that a yearly produce of 400lbs. removes from the soil 50lbs. of nitrogen and 12lbs. of potash per acre. Cow-dung and linseed, or castor cakes, are the only manures which so far have been used to any extent by tea planters, and with considerable success so far as a re-supply of nitrogen and some of the soluble salts is concerned; but neither of these manures contains potash. As an instance of the value of its presence in tea, I may mention having found that, while the tea of young gardens, which fetch high prices, has plenty of potash, low-priced Darjeelings, raised from washed-out soils, scarcely show a trace; in fact, in some samples I have found none at all. It will be an assistance perhaps to planters to have a simple test for this valuable ingredient. They may search chemical text books in vain for any but the most elaborate means of detecting its presence; but I find that for a rough test it is sufficient to stir into the tea infusion (in a wineglass) as much tartaric acid as will cover the point of a pocket knife (part of the contents of the white packet of a seidlitz powder will do), when a slight cloud will indicate a trace, and a precipitate an abundance of potash.

Were sea-weed available in any quantity, it should pay to produce a manure from its ashes, rich in both nitrogen and potash. Such a manure, mixed with a small proportion of bone ash and sulphate of soda, is, I believe, the only efficient food for the tea plant, and which, applied in moderate quantities, would keep the soil in condition.

In conclusion, I would suggest that planters ought, at least once a year, to have their teas analysed, as the quality ought to be brought up to that of the analysis given above. It is not enough to have continual brokers' reports repeating the well-known fact that the teas are greyish, blackish, bold, wiry, &c., &c.; planters should know of what their teas really consist. They can then add to the soil the constituents in which it is deficient, and return those which the teas have extracted. It only remains for a chemist of experience to come forward (and there are one or two such in Calcutta) and name a reasonable fee for the analysis—something

that planters would not object to pay, while they would demur to give a fancy price.

Urine Manure.

M. Raoul Brullé has come forward with a new method of treating the urinous portion of town sewage in preparing it for manure, for which he claims numerous advantages over those hitherto in use. The oldest system is probably the Flemish, which consists in conveying the excreta away from the towns and storing them in large masonry tanks with the addition of water. In Paris the sewage is deposited at La Villette, thence to be directed by machine power through a long conduit to Bondy, where it lies in pools to ferment. In this manner its urea is transformed into carbonate of ammonia, from which the sulphate is obtained by distillation, while the solid matters are compressed and dried, and these sold as "poudrettes." Another system is the direct application of the urine to the irrigation of the soil, as practised on the plain of Gennevilliers. All of these processes are attended with grave inconveniences. (1.) The system of fermenting for three or four years to convert the urea into carbonate of ammonia is extremely unprofitable from the length of time it occupies, during which the capital involved is producing no interest. (2.) Masonry cisterns and tanks are very costly if made impermeable, as they ought to be. (3.) The foul emanations from them are a source of annoyance and disease. (4.) The cost of distillation and conversion of the disengaged ammonia into sulphate is considerable. (5.) The drawbacks of the direct irrigation system are well known. The inhabitants protest against the nuisance, and the accumulation of putrid emanations infects the soil. From all these disadvantages M. Brullé contends that his system is free. It is based, on the one hand, on the property of plaster to absorb, and thus reduce to a solid form large quantities of urine; and, on the other, on the greatly increased quantity of fertilising matter which can be introduced into the medium, by subjecting the plaster to repeated saturations, and driving off the superfluous moisture after each operation by means of hot air. In this way a solid manure can be obtained containing 5 per cent. of nitrogen and 1 to 2 per cent. of phosphoric acid, rich in fertilising elements, easy of transport and containing not only five times as much nitrogen and phosphoric acid as fresh urine itself, but also all the mineral salts of the urine, which have a certain manurial value. The plaster itself also increases such value. In this system, therefore, interest upon capital is constantly occurring, instead of the latter lying idle for years, for the urine can be treated by it at once, and the produce is ready for sale in a very few days. In addition to these economic advantages, the process is absolutely free from all objections upon sanitary grounds.—*Home and Colonial Mail.*

The Chemical Analysis of Tea Ashes, and the Scientific Manuring of the Plant to produce leaf.

Mr. H. Cottam writes on this subject, as follows, to the *Ceylon Observer* :—

In my letter on the subject of soil suitable for the cultivation of the tea plant, I gave you the chemical analysis of the soil of Assam and China, as given by Dr. McClelland and Mr. Piddington. Both these gentlemen differ considerably; for instance, the larger item is silex, sand, or dusty matter, 130 parts out of 184 given by Dr. McClelland, against 85 parts out of 100 given by Dr. Piddington. Vegetable matter is given by the former as 16 parts, and as only 1 part by the latter. In iron they agree pretty nearly 6 and 7·40 respectively; but as regards alumina the difference is 6½ and 3·50. Unfortunately no chemical analysis has been made of late years, either of the soils or of the ashes of the plant. The Superintendent of the Assam Company sent some samples of his soils for analysis; but, I am informed lately, has not received an answer up to date.

This is a subject which tea planters sooner or later will have to turn their attention to. They cannot take heavy crops of leaf from their tea bushes without "feeding the cow that gives the milk." At present the country in which tea is grown is young, fresh and vigorous, and no doubt will yield abundant crops for years to come, but like Ceylon, the old districts will go to the wall, if neglected, for the sake of new ones.

A gentleman, well qualified to express an opinion on the subject of manuring the tea bush, informs me that bone-dust, phosphate of lime and ammonia, as also potash, would be the best manures for the growth of the tea bush. Oil-cake with the ashes of any rubbish would give the potash. The nitrogen

and potash, or the nitrogen of the oil-cake combining with the hydrogen of either water or air would yield ammonia.

Phosphate of lime, potash and ammonia are the three principal requisites for forming the manure best suited for tea.

Hitherto the tea planters of Assam have not thought manuring a necessary item of expenditure; and, throughout my travels through the tea districts in the Assam Valley, I observed that no good cattle establishments exist as in the island of Ceylon, where at the present time coffee planters pay great attention to the making of compost heaps and rearing of cattle for manuring purposes, even to the catching of urine in cisterns, which is poured over the heaps of manure to hurry on the decomposition of the grass mixed up with the cattle dung, enriched by passing poonac through the cattle.

Colonel Money mentions in his work on tea that manuring was carried on with great success in Chittagong, and says that he was struck with the frequency and abundance of the flushes and the strength and flavour of the tea; and that, although manuring was condemned by Chinese as having a tendency to spoil the flavour of teas, it was greatly approved of by the Calcutta brokers, and the manured tea fetched high price in the market. He speaks highly of cattle manure (always excepting [as superior] night soil and the excrement of birds which cannot be procured). It is not heating like horse-dung, and may be applied in large quantities without any risk, the fresher applied the better.

The Assam Company carry out a valuable system of burying prunings, afterwards trenching up in rows.

Tea Fertilizing Trees.

I notice in your Editorial of 19th August "A correspondent from Upper Assam" writes: "I dare say that there are planters who are not aware that there are two trees in especial under which tea thrives in the most wonderful manner—the Sowah and Modar." Your correspondent must, I think, be confusing the Sowah (Sago Palm) with the Saw. The Sowah completely checks the growth of tea—at least the two jâts I have met with.

Your correspondent is, however, correct as regards the Modar, and to the list he might add the Saw (above mentioned) and Medelua—the latter considerably superior to either for producing healthy and frequent flushes; but I am, like your correspondent, unable to say from what source the benefit is derived, but should say it is not "shade," but some chemical ingredient imparted to the soil, which just suits the requirement of the tea plant. My reason for coming to this conclusion is, that the Medelua, after being cut down many years and nothing left but the remains of a rotten stump, still grows vigorously; even after the last vestige of the stump has disappeared, it is easily known where one of these trees once stood.

If the soil was analyzed, no doubt an antidote for tea could be found. I shall be glad to supply the soil for analysis.

Drainage.

The removal from the ground of any waters whose sojourn might be pernicious, from whatever source they may be supplied, and the provision of an adequate discharge for those waters, constitute the art of drainage.

It may be divided into two great branches, namely, the drainage by means of *open cuts*, or the drainage by means of *subterranean channels*.

Drainage by open cuts of course can only be applicable when the waters to be removed do not attain a level superior to that of the ground, and when there is an efficient outfall, either natural or artificial; and its success depends upon the maintenance of a regular permanent discharge of the waters supplied by the collecting drains. The surface of the water in these collecting drains must always be kept at such a distance from the surface as to prevent any injurious action upon the vegetation of the land, for it is to be observed that drainage by open cuts is almost exclusively reserved for agricultural districts. In the outfall drains, the water must not be allowed to stagnate, and the cuts must be formed of such dimensions, and in such directions, as to ensure the discharge in the smallest possible time.

The drainage of bogs, or swamps, in mountainous districts, may very often give rise to the application of other laws; as for instance, when the water, which maintains the per-

manent state of humidity it is desired to remedy, is supplied by springs rising under considerable pressure; or when the swampiness of the locality arises from the mere accumulation of water at the wet seasons of the year. The Bog of Allen was an instance of the former condition, and in that case the water was relieved by forming a series of artificial channels, or vertical pipes, through which it rose, and poured into a new outfall drain. The Chat Moss, however, was drained simply by means of open cuts, so traced as to carry off the surface waters as rapidly as they fell, and by a trifling improvement in the outfall. The latter operation is, moreover, the principal one required to obviate the supposed inconvenience from the occasional accumulation of rain waters; and it may be stated that there are many thousand acres of the best land, now unproductive, which might be easily brought into cultivation by the execution of some unimportant works to lower the level of the natural water courses of the districts in which these now valueless tracts are situated. There are numerous tracts which only require to be thus treated.

A system of drainage, exclusively by open cuts, is, at the present day, so rare in all countries, where there is the ordinary variety of hill and dale, that the meaning of the generic term, *drainage*, has almost been perverted to that of a subterranean drainage. There are, however, very essential differences between the conditions which are adapted to these respective modes of operation, and it is dangerous therefore to admit any confusion in the names by which they are characterised. One of the most important of these differences arises from the fact that in open drainage little reference need be made to the daily rainfall, provided the outfall be established under such conditions as to prevent any serious accumulation of water, whilst the rainfall of the particular district will regulate the dimensions to be given to a series of subterranean drains, in connection with the usual considerations with respect to the permeability of the strata. It usually happens also that little reference need be made to the permeability of the low lands, to which alone the open cut drainage can be economically applied; because the level of the water in the cuts is usually maintained at a permanent line, and it is only the excess of water which is removed. In fact, in the districts wherein drainage is effected by open cuts, the class of cultivation is usually such as to require the presence of a definite quantity of water in the subsoil, and very serious evil results from an abnormal lowering of the water line. In districts wherein subterranean drains are used, however, it is essential to remove as rapidly as possible any waters which might have a tendency to stagnate around the roots of the plants, or to prevent the surface of the ground from being cooled by the rising of springs. The practical details of the two systems of drainage are naturally much affected by these peculiar local conditions, and in the case of the subterranean drainage the physical outlines of the country will further affect the question by reason of the greater or less facilities they offer for the throwing off, or retaining surface waters.

In properly drained land, situated at such levels as to allow the water collected in the outfall drains to flow freely, the surface of the ground is always dressed into such tables, or ridges, as to ensure the discharge of the water falling from the atmosphere which does not permeate the surface itself; and the drains have only to carry off the water which soaks through the ground. Evidently, under such circumstances, the drains must be placed at distances varying according to the degree of permeability of the ground, and also of the nature of the sub-soil, though the latter condition would rather affect the depth of the drains than their lateral distances. Some discussion has taken place amongst the leading professors of the art with respect to these details; but they seem to have simply fallen into the error of all absolute theoreticians,

for it must evidently be absurd to apply indiscriminately any system of either deep or shallow drains; and it must as evidently be the proper course to modify both the depth and the distance apart of the drains, according to local circumstances.

The only invariable condition affecting the depth of drains is, that they must be beyond the reach of any agricultural operations. In light lands the plough often does not descend more than 8 inches, whilst in heavy stiff clays, the depth of the plough is not less than from 18 to 20 inches. It is, therefore, customary to place the drains, even in what is called shallow drainage, at a minimum depth of from 20 to 24 inches, measuring from the top of the material constituting the channel to the surface of the ground. The maximum depth at which drains are laid does not exceed under any circumstances from 6 to 8 feet, and it is only occasionally that the depth is made more than 4 feet 6 inches from the surface. In shallow drainage the number of the drains is increased, and they are brought closely together; whilst in deeper drainage the distance is augmented. Smith of Deanstone, who was an advocate for shallow drains, usually made them from 6 to 8 yards apart, and about 3 feet deep. Parkes recommends, on the contrary, that the distances asunder should be made from 13 to 20 yards, and that the depth should be made from 4 feet 6 inches to 8 feet. The choice of the respective systems must, however, be regulated by the nature of the sub-soil as much as by that of the soil itself, and very careful observations should be made before either of them is adopted.

The width of the trenches will be regulated by the depth of the drain rather than by any other condition, for it must be made wide enough to allow the workmen to perform easily any of the operations required for levelling the bottom of the excavation or for placing the pipes or other materials. In practice it is found that, for a depth of 3 feet, it is sufficient to give a width of 1 foot at the surface, and 3 feet at the bottom; for a depth of about 4 feet, these widths become respectively 1 foot 4 inches and 8 inches; whilst for a depth of 8 feet they become respectively 2 feet 6 inches, and 1 foot 2 inches, even in hard resisting grounds, which are not likely to cave in, as the workmen say. The width of the bottom of the trench, it is to be observed, is regulated rather by the necessity for its being sufficiently wide to enable the workmen to lay the pipes than by any other condition; and it is also found, practically, that it is not possible to secure the regularity of the inclination of the bottom, unless the men can stand directly upon it. The success of a system of drainage depends greatly upon the last-named condition,—namely, the regularity of the inclination, as also upon its being made such as to ensure the constant flow of the water. Generally speaking, a fall of 1 in 200, in the minor drains, will suffice, especially when the drain-tiles have been well and carefully laid.

It is not desirable to make the sub-drains of any great length if their inclination should be considerable; because, under such circumstances, it is possible that the head of water in the pipes or channels might burst them, and there is always danger of an accumulation of silt. Generally speaking, the smaller drains do not exceed 100 yards in length before discharging into sub-mains of larger dimensions; and the latter are limited to a length of about 300 yards before discharging into open ditches, or into the main outfall of the district. If it were possible, it would even be preferable to make the small pipes or channels themselves discharge into the open ditches, without using any sub-mains. An important remark to be made with regard to every description of subterranean channel is, that they must be carried as far as possible from trees or hedges; because the roots of the latter have a remarkable avidity for water, and they are sure to find their way into any channel in

their immediate neighbourhood. The sub-mains should be laid a little below the ordinary line of the smaller channels, in order to communicate to the water a greater velocity when it approaches the point of junction; and the junctions should be made with a curve upon the plan, so as to avoid any direct interference with the lines of flow of the respective streams.

There are several modes employed for the purpose of filling in the trenches of drains, the choice of which must be regulated by local conditions of economy; though, as a general rule, it would unquestionably be better to resort to the use of pipes of stone or of earthenware. The cheapest, but also the least permanent, mode of forming the channel consists in cutting a species of shoulder near the bottom of the trench, upon which a thick sod of the grass from the surface is laid, with the grass downwards, and then filling in the remainder of the trench with light permeable earth. In countries where stones are easily obtained, it is customary to use them for the purpose of forming the channel; and this is effected by placing two slabs in an inclined position to one another, and covering them to a certain height with the smaller broken stones. Both the stone and the turf channels are, however, liable to become silted up, or even to be choked, by the precipitation of the salts which the waters may hold in solution; and it is on these accounts that agricultural engineers have, of late, given very decided preference to the use of tile or pipe drains. Formerly the tile and shoe drains were the most generally used; and, in filling them in, it was customary to lay flat tiles or shoes at the bottom of the trench, which shoes were made about 14 inches long and about 5 inches wide, and upon them to place the tiles, of the same length, and from 3 to 4 inches wide and 4 or 5 inches high. Of late years cylindrical tubes have been almost exclusively used, not only on account of the economy of their manufacture, but also of the greater ease and regularity with which they can be laid. These pipes are made of almost any diameter, from 1 foot to 1 inch, and of lengths varying from 14 inches in the smaller dimensions to 2 feet in the larger ones; the 2-inch pipes being generally used for the small drains, and the 4 or 6-inch pipes for sub-mains under normal conditions. When cylindrical pipes are used in peaty or very moveable soils, it is necessary to protect the abutting joints by means of collars; but in ordinary soils no such precautions are required to be observed.—*English Cyclopædia.*

DRAINING.

As a certain quantity of moisture is essential to vegetation, so an excess of it is highly detrimental. In the removal of this excess consists the art of draining. The same, or nearly the same truth, may perhaps be better expressed thus: As water stagnant in the soil is prejudical to the growth of all our cultivated plants, fertility is greatly promoted by the art of draining, which induces its circulation through the soil.

Water may render land unproductive by covering it entirely or partially, forming leys or bogs; or there may be an excess of moisture diffused through the soil and stagnating in it, by which the fibres of the roots of all plants, which are not aquatic, are injured, if not destroyed.

From these different causes of infertility arise three different branches of the art of draining, which require to be separately noticed.

1. To drain land which is flooded or rendered marshy by water coming over it from a higher level, and having no adequate outlet below.

2. To drain land where springs rise to the surface, and where there are no natural channels for the water to run off.

3. To drain land which is wet from its impervious nature.

In hilly countries it sometimes happens that the waters which run down the slopes of the hills collect in the bottoms where there is no outlet, and where the soil is impervious. In that case it may sometimes be laid dry by cutting a sufficient channel all round, to intercept the waters as they flow down, and to carry them over or through the lowest part of the surrounding barrier. We shall see that this principle may be applied with great advantage in many cases where the water could not be drained out of considerable hollows if it were allowed to run into them.

When there are different levels at which the water is pent up, the draining should always be begun at the highest; because it may happen that, when this is laid dry, the lower may not have a great excess of water. At all events, if the water is to be raised by mechanical power, there is a saving in raising it from the highest level, instead of letting it run down to a lower from which it has to be raised so much higher.

The draining of land which is rendered wet by springs arising from under the soil is a branch of more general application. The principles on which the operations are carried on apply as well to a small field as to the greatest extent of land. The object is to find the readiest channels by which the superfluous water may be carried off; and for this purpose an accurate knowledge of the strata, through which the springs rise, is indispensable. It would be useless labour merely to let the water run into drains after it has sprung through the soil, and appears at the surface, as ignorant men frequently attempt to do, and thus carry it off after it has already soaked the soil. But the origin of the springs must, if possible, be detected; and one single drain or ditch, judiciously disposed, may lay a great extent of land dry if it cuts off the springs before they run into the soil. Abundant springs, which flow continually, generally proceed from the outbreaking of some porous stratum in which the waters were confined, or through natural crevices in rocks or impervious earth. A knowledge of the geology of the country will greatly assist in tracing this, and the springs may be cut off with greater certainty. But it is not these main springs which give the greatest trouble to an experienced drainer; it is the various land springs which are sometimes branches of the former, and often original and independent springs arising from sudden variations in the nature of the soil and subsoil.

Thus in one situation boring will bring water, and in another it will take it off. This principle being well understood will greatly facilitate all draining of springs. Wherever water springs there must be a pervious and an impervious stratum to cause it, and the water either runs over the impervious surface or rises through the crevices in it. When the line of the springs is found, the obvious remedy is to cut a channel with a sufficient declivity to take off the water in a direction across this line, and sunk through the porous soil at the surface into the lower impervious earth. The place for this channel is where the porous soil is the shallowest above the breaking out, so as to require the least depth of drain; but the solid stratum must be reached, or the draining will be imperfect.

When there is a great variation in the soil, and it is difficult to find any main line of springs, it is best to proceed, experimentally, by making pits a few feet deep, or by boring in various parts where water appears, observing the level at which the water stands in these pits or bores, as well as the nature of the soil taken out. Thus it will generally be easy to ascertain whence the water arises, and how it may be let off. When there is a mound of light soil over a more impervious stratum, the springs will break out all round the edge of the mound; a drain laid round the base will take off all the water which arises from this cause, and the lower part of the land will be effectually laid dry. So, likewise, where there is a hollow, or depression of which the bottom is

clay with sand in the upper part, a drain laid along the edge of the hollow and carried round it, will prevent the water running down into it, and forming a marsh at the bottom.

When the drains cannot be carried to a sufficient depth to take the water out of the porous stratum saturated with it, it is often useful to bore numerous holes with an auger in the bottom of the drain through the stiffer soil; and, according to the principle explained in the diagram, the water will either rise through these bores into the drains, and be carried off, and the natural springs will be dried up, or it will sink down through them, if it lies above. This method is often advantageous in the draining of peat mosses, which generally lie on clay or stiff loam, with a layer of gravel between the loam and the peat, the whole lying in a basin or hollow, and often on a declivity. The peat, though it retains water, is not pervious, and drains may be cut into it which will hold water. When the drains are four or five feet deep, and the peat is much deeper, holes are bored down to the clay below, and the water is pressed up through these holes, by the weight of the whole body of peat, into the drains, by which it is carried off. The bottom of the drains is sometimes choked with loose sand, which flows up with the water, and they require to be cleared repeatedly; but this soon ceases after the first rush is past, and the water rises slowly and gradually. The surface of the pit being dried, dressed with lime, and consolidated with earth and gravel, soon becomes productive. If the soil, whatever be its nature, can be drained to a certain depth, it is of no consequence what water may be lodged below it. It is only when it rises so as to stagnate about the roots of plants that it is hurtful.

When a single large and deep drain will produce the desired effect, it is much better than when there are several smaller, as large drains are more easily kept open, and last longer than smaller; but this is only the case in tapping main springs, for if the water is diffused through the surrounding soil, numerous small drains are more effective. But as soon as there is a sufficient body of water collected, the smaller drains should run into larger, and these into main drains, which should all, as far as is practicable, unite in one principal outlet, by which means there will be less chance of their being choked up. When the water springs into a drain from below, it is best to fill up that part of the drain which lies above the stones or other materials which form the channel with solid earth well pressed in, and made impervious to within a few inches of the bottom of the furrows in ploughed land, or the sod in pastures; because the water running along the surface is apt to carry loose earth with it, and choke the drains. When the water comes in by the side of the drains, loose stones or gravel, or any porous material, should be laid in them to the line where the water comes in, and a little above it, over which the earth may be rammed in tight, so as to allow the horses to walk over the drain without sinking in.

It sometimes happens that the water collected from springs, which caused marshes and bogs below, by being carried in new channels, may be usefully employed in irrigating the land which it rendered barren before; not only removing the cause of barrenness, but adding positive fertility. In this case the lower ground must have numerous drains in it, in order that the water let on to irrigate it may not stagnate upon it, but run off after it has answered its purpose.

The third branch in the art of draining is the removal of water from impervious soils which lie flat, or in hollows, where the water from rain, snow, or dews, which cannot sink into the soil on account of its impervious nature, and which cannot be carried off by evaporation, runs along the surface and stagnates in every depression. This is by far the most expensive operation, in consequence of the number of drains required to lay the surface dry, and the necessity

of filling them with porous substances, through which the surface water can penetrate.

It is very seldom that a field is absolutely level; the first thing, therefore, to be ascertained is, the greatest inclination and its direction. For this purpose there is an instrument essential to a drainer, with which an accurately horizontal line can be ascertained, by means of a plummet or a spirit-level. A sufficient fall may thus be found, or artificially made in the drains, to carry off the water. One foot is sufficient fall for a drain 300 feet in length, provided the drains be not more than 20 feet apart. It is evident that the drains cannot always be in a straight line, unless the ground be perfectly even. They should, however, never have sudden turns, but be bent gradually where the direction is changed. The flatter the surface and the stiffer the soil, the greater number of drains will be required. It is a common practice with drainers to run a main drain directly down the slope, however rapid, and to carry smaller drains into this alternately on the right and left, which they call herring-bone fashion. But this can rarely be approved of. It generally happens that, besides surface water, there are also some land springs arising from a variation in the soil: these should be carefully ascertained, and the drains should be so laid as to cut them off.

The following memoranda are suggestive of the principles which should guide practice on the subject; and may serve also to indicate directly what correct practice generally is:—

Food enters plants chiefly as dissolved in water. The relations of water to the plant and to the soil are therefore of the first importance. Water is a powerful solvent, extracting soluble matters from the air and from the soil through which it passes. The air in rain-water contains one-half more oxygen, and three to six times more carbonic acid than the air of the atmosphere. Rain-water also contains nitric acid and ammonia.

The contents of rain-water, its solvent powers exerted on the mineral and other matters useful as food for plants in the soil, and its relations to temperature, are the three points on which its fertilising influences depend.

Water gets into land in three ways: 1st, as rain falling on the surface; 2nd, as spring water; 3rd, by capillary attraction exerted on a wet subsoil.

Water leaves the land in three ways: 1st, by running off its surface; 2nd, by evaporating from its surface; 3rd, by percolating through its substance. In the first case it is wholly inoperative, except in so far as it does mischief by carrying off the finer surface particles of the soil either in solution or otherwise. In the second case it carries off, in great measure to waste, matters capable of evaporation, and useful as food for plants, which it holds in solution; but the most considerable result of evaporation is the loss of heat consequent upon it. As much heat as the burning of two or three ounces of coal could produce is lost by the evaporation of 1lb. of water. Dalton's gauge indicated an annual evaporation of 24 inches out of 33 inches of an annual rainfall. Dickenson's gauge indicated an evaporation of 15 out of 26. During percolation through the land, which is the third way in which water leaves the soil, it introduces into the land the temperature of the air, it introduces atmospheric elements into the soil, it dissolves food out of the land, and carries it to the roots of plants.

The principal practical benefit derived from drainage is the easier and cheaper cultivation of which drained land is capable. The greater fertility of such land is in a measure due to the whole substance of it, its whole internal surface being brought under the influence of air and rain-water.

The object of drainage then is to induce the percolation of rain-water through the soil. To this end conduits are laid under ground at such a depth, and at such intervals, as experience finds sufficient. And the points connected with the practice to be con-

sidered are (1), the depth, as limited by the outfall, as desirable in the interests of fertility, and as necessary owing to the constitution of the soil; (2), the frequency and capacity of the drain to correspond with the rainfall, and with the character of the soil; (3), the arrangement of the drains, uniform to correspond with the uniformity of the supply in rain, or irregular to correspond with the subsequent irregular distribution of the rain-water throughout the soil.

(1). As to depth—its principal limit is cost—that it should be considerable is desirable on the ground of the greater depth of material being thus fertilised and made useful to the plant. Drains 2 and 3 and 4 feet deep may, other things being equal, cost a large sum per acre; but there are thus brought into use 18, 30, and 42 hundred tons of earth per acre, which is after the rate of 600, 700, and 800 tons for every pound of expenditure—so that the deeper and costlier drain may be the cheaper in the end. But depth is regulated to some extent by the capillary attraction of the soil upon the water which it holds, a considerable height of column to give the weight necessary to force that attraction being required.

(2). The frequency of drains must be greater according to the greater quantity of water falling in a given time as rain, to which the climate exposes the land to be drained, and according to the difficulty of percolation which the land presents. In practice the quantity of exit provided in the least efficient drainage is sufficient for the removal of the largest probable rainfall. The size of the pipes is determined by other considerations than the quantity of water they have to deliver—a larger pipe is rendered desirable by the fact that when a smaller one is used a very slight displacement breaks the continuity of the pipe.

The interval between drains is to be determined by the rainfall and the capability of percolation. The depth of drains should be allowed very little influence on the interval. The direction of drains should be right down the slope, simply because when once the water gets into them, the shortest way out of the field is the best.

(3). The arrangement of the drains at varying intervals is necessary sometimes, to suit the varying distribution by which rain-water is accumulated in certain spots, so that springs and swamps are produced.

As a general rule, however, drains as nearly 4 feet deep as may be, and from 5 to 10 yards apart,—greater according to the porosity of soil and subsoil, should be laid parallel to one another, and for the most part straight down the slope. The material used should be the common cylindrical pipe tile, about 2 inches in the bore; less than this at the upper part of the drain, more in the lower.

In commencing drainage, prepare a general plan for the estate. Seek, in the first place, by straightening water-courses and draining springs, to give rapid exit for all the water that comes into the land otherwise than from the clouds. In the after drainage of the land the general rule is to commence the drainage of the lowest part first, attending to the final outfall first of all. There are exceptional cases where the drainage of a higher land may, to some extent, remove water at once which fed the lower grounds. When spring water is removed, drain as deep (to 4 feet) as the outfall will permit, and with such attention to uniformity of interval as the adhesiveness or porosity of of the soil shall indicate. Notwithstanding the outcry against rules and systems in drainage—uniformity of interval *is* the rule, and the so-called "gridiron" system is the safest; departures from either being exceptional.

Before carrying out the system however let all such obstacles and nuisances (crooked hedge rows, old ditches, and timber) as it is intended to remove be removed.

Trial holes are useful to determine the interval which may be desirable between the minor drains. Ascertain

the experience of your neighbours on this point. Widen the interval, because the soil admits of the more easy percolation of the water, not because you have made your drains deeper.

Whatever system of drainage be adopted, see that it be thoroughly done. "Nothing is stronger than its weakest part," and a defective patch may check the cultivation of the whole field. Subsoil ploughing across the drainage tends to its immediate and increased efficiency.

In draining fields it is usual to make the outlets of the drains in the ditch which bounds them. The fewer outlets there are, the less chance there is of their being choked; they should fall into the ditch considerably above the bottom, and a wooden trunk, or one of stone, should be laid so that the water may be discharged without carrying the soil from the side of the ditch. If there is water in the ditch, it should be kept below the mouth of the drain. The outlets of all drains should be repeatedly examined to keep them clear; for wherever water remains in a drain, it will soon derange or choke it. The drains should be so arranged or turned that the outlet shall meet the ditch at an obtuse angle towards the lower part where the water runs to. A drain brought at right angles into a ditch must necessarily soon be choked by the deposition of sand and earth at its mouth.

As the draining of wet clay soils is the only means by which they can be rendered profitable as arable land, and the expense is great, various instruments and ploughs have been contrived to diminish manual labour and expedite the work. Of these, one of the simplest is the common *mole-plough*, which, in very stiff clay, makes a small hollow drain below the surface, by forcing a pointed iron cylinder horizontally through the ground. It makes a cut through the clay, and leaves a cylindrical channel, through which the water which enters by the slit is carried off. It requires great power to draw it, and since steam-power has been used for the purpose, strings of pipe-tiles have been drawn in behind the "mole," so as to leave permanent tunnels or conduits at any required depth beneath the surface.—*English Cyclopædia.*

It would be well to stick to the old open drains, taking care to give them a decent fall, and to clean them out once annually during the cold weather. Tile draining would cost a great deal of money, and the drains would, I think, owing to the inordinate rainfall during the wet season, soon silt up and become useless.

The only objections to open drains are the drying of the adjacent soil through exposure during the cold season, and occasionally, if there be a considerable fall, to the washing away of mineral matter—some of it useful as plant food—in a fine state of division.

Pipe and tile drains at home are of course covered in as soon as the pipes or tiles, as the case may be, have been laid; but we must remember that the trifling rain-fall in Engdand renders it impossible, without direct local experiment, to form, from a knowledge of the efficacy of these systems of drainage in that country, any reliable opinion as to the probabilities of their efficiency, or its converse, if tried in the tea districts of India,—in some of which they would have to dispose of a rain-fall at least *five* times as great as that with which the British agriculturist has to deal. There is, in my opinion, serious cause for apprehension that by silting up and by choking, from the roots of the Tea-bushes, (for the deeper the drainage, the deeper will their tap roots descend) the enormous outlay which would have to be incurred in tile or pipe draining,—an expenditure suited only to the performance of a real and permanent improvement—might be utterly and irremediably thrown away.

I have made—upon stiff, wet, low-lying clay—open drains which have answered their purpose admirably; they are inexpensive to make, and

there is no fear of their ever giving trouble. An ordinarily strong coolie will cut and throw up 108 c. ft. of earth per diem,—that is each man will do 3 × 3 × 12 feet, supposing the drains to be 3 × 3, shallower and narrower than which, in your correspondent's case, I should hardly advise them to be dug.

In some of the almost dead levels of Assam, drainage is a very difficult operation, on account of the height in the soil of the water-table in the rains: without a good outlet real drainage is of course impossible, and the drain should be commenced not from the top, but from the *outlet*, and be taken thence *up* the slope.

Wherever there is any doubt about the fall of the block to be drained, a "Dumpy" level should be used, and any intervening rises met with in the drain line be cut through at whatever greater depth may have been rendered necessary by the height of the rise, so as to leave the slope at the bottom of the drain unchecked: thus, if, at 10 nulls, for a distance of 3 nulls, a rise gradually increasing from three inches to six inches be encountered, the drain through the said 3 nulls will have to be cut from 3 to 6 inches deeper than the first 10 nulls were dug. If attention be not paid to this point, silt will accumulate wherever the smallest check is encountered, and the drains will require more work in the cold weather to clean out than they would if dug as directed. If my suggestions meet with confidence I should advise to dig the drains on a field of stiff water-logged clay, at distances varying according to circumstances, but not exceeding 36 feet; some may have to be made even 18 feet apart. The depth will vary greatly with local circumstances, but I should not advise to make drains shallower than 3 feet on the average and the deeper one can make them the more effectual will be their action. If there be no appreciable fall until near the outlet, (which I am assuming to be some natural water-course "tola" or river) dig the drains at a depth of 4 feet, or more if necessary at the portion near the outlet, and gradually slope them up to 3 feet, or even less, if advisable, at their termination.

If you have labour to perform both operations in one and the same season, I would advise to drain first and to trench-hoe afterwards, taking care of course, while performing the latter operation, to leave a few inches of untouched earth adjacent to his drains: and if you cannot perform both operations in one and the same season, give the right of precedence to *drainage*, without which the otherwise splendid operation of trench-hoeing would, in water-logged land, be of small cultivatory value to the tea, and would certainly not aid in getting rid of the over-plus of moisture in the soil. I have seen more damage caused to tea in Assam from want of drainage than from any other cause (want of cultivation included), and yet—strange to say—planters are as a rule, although they admit its utility, reluctant to incur any expenditure under this head.

Although I am of opinion that it is impossible to over-estimate the value of cultivation, and though I maintain that whatever amount we may spend upon thorough deep-hoeing, trenching, etc., etc., above the average, we shall certainly recover with handsome interest, in the increase of yield thereby induced, still it is not, to my mind, of any great use to go on cultivating water-logged land which will never do anything *undrained*, and which requires only drainage to enable it to profit by the cultivation which in its saturated condition is only thrown away upon it; and I would therefore, in the case of such land, throw all my available labour into draining it thoroughly, before I thought of bestowing upon it more cultivation than should be found sufficient to keep it out of jungle.

C. E. M. B.

First, if the land be low, but worth spending some money over, *i.e.*, if it be in the middle of the garden or near a road, and planted with young or healthy bushes,

dig *deep* drains—say from 3 to 6 feet, if necessary taking up a line of tea at every 20 feet or so at right angles across and across, smaller drains being made between the large ones This would raise the general level of the land about six inches.

If the land be low, and covered with old or scraggy plants, my advice is to waste as little money on it as possible.

In such a climate as Assam, open drains are, I think, preferable to closed-in ones, in stiff soil; and for subsoil drainage, tiles would be almost useless, and even piping, unless very large, would not be much better. Of course pipes and tiles would be no saving, when land is cheap. As for the earth washing into the drains, the men could always clean them out each time they went round hoeing.

Again, why not try and improve the consistency of the soil by manure?

If there be any forest land close by, about two inches of the surface soil (which is leaf mould) mixed with prepared cow-dung or crushed bones, or both, would be very useful; but if there be only grass jungle, let its leaves be collected and buried between the lines, about a foot from the surface, (the more the better), and the stems might with advantage be cut, dried, burnt to ashes and applied round the roots of the plants.

If sand be available, a quantity mixed into the soil at each hoeing during the rains would be beneficial.

Lastly, if cowdung be procurable,—then use it.

If one cannot wait to let the dung rot, put it in large quantities, between the lines, not near the bushes, taking care to cover it well over with earth.

This method would also attract the assistance of a numerous crowd of drain-diggers in the shape of beetles and worms, which would in time render any soil porous.

Mr. Bancroft mentions that some acres, from the circumstance of being close to cooly lines, gave 17 to 19 maunds per acre, when the rest of the garden gave only 4 or 5 maunds; also that the subsoil should be examined and drained. Many soils have a natural drainage owing to the materials of which the subsoils are composed being of a porous nature; but others have a subsoil exceedingly stiff, which requires to have drains made through it; and on hill sides this may be accomplished by trenching or burying in deep holes the weeds and jungle.

PART III.—MANUFACTURE.

Withering.

Neptune.

As tea is not made to look at, I am satisfied in having a greater percentage of it broken, caused by rolling the scarcely withered leaves, if I can, in process of manufacture, cause the outturn to be of improved strength and quality of liquor. The leaves commence to decay shortly after they have been removed from the bushes, sooner or later, dependent upon the state of the weather and their condition of moisture, and this is accelerated or retarded by the temperature of withering house, amount of air and light they are exposed to, degree of thickness spread on machans, and finally, though the most important of all, to the number of hours that have elapsed prior to rolling. To make tea of really good quality, strength and flavor, all the conditions being similar, the leaves should be plucked and manufactured separately and as soon as practicable after being brought in. I entirely disapprove of leaf being withered in the sun.

The Oldest Planter in India.

I do not approve of keeping leaf through unfavourable weather, and would prefer breaking it in rolling to keeping it over. I often wither over charcoal, and by laying a cloth over the wire gauze this process can be carried out without sacrificing the desired salmon color.

Chittagong Planter.

Over-withered leaf, in my experience, takes a good twist and makes a pretty tea, but liquors dull. Rather under-withered leaf, on the other hand, though it breaks in the roll and weighs out ugly looking, generally gives a flavory good liquor, provided it has been fermented enough. Brokers' reports are at times misleading. Reference for instance to the leaf as having been apparently "*badly* withered," leads to the supposition of *insufficient* withering. I fell into this mistake, and I dare say others have done the same. Now I keep back the withering in dry weather with beneficial results.

I believe the Chinese manipulate freshly-plucked leaf when practicable. It may be that we have a lot still to learn from them, for if, as it is so constantly stated, they only send their poor teas to England, and these successfully compete with all but best quality Indian, the Chinese must have improved the art of manufacture, while we are standing still, if not falling behind.

A Cachar Planter.

I consider that one of the greatest causes in the change in India teas during the past six years has been the weather. During these past years we have never had what we may call "good tea weather"—either had heavy rains or long drought; some years ago the rains were more even with hot days. This has a good deal to do with the inferior teas turned out lately in heavy wet weather.—*Indian Tea and its Manufacture.*

Withering.

This is one of the most important points connected with the manufacture of good tea. With the present increased number of iron-roofed buildings, and greater facilities for withering, we fear a good deal of leaf is allowed to get over-dry and discolored, and to this we partly attribute the growing complaints by the trade of the thinness and dulness of the present teas. The leaf should, if possible, be brought to a perfectly flaccid state, but it should never be allowed to exceed this, and it would be better to roll the leaf slightly under-withered, which would give good strong tea even if a good deal broken, but would be preferable to those weak teas, though of better appearance, made from dry sapless leaf.

Rolling.

I object to heavy rolling either by hand or machine, unless the leaves have been gathered *during* very rainy weather, and they are themselves also over-charged with moisture, in which case it must be resorted to but merely to expel the superfluous water. In all other conditions I maintain that the less pressure is exerted upon them the better and stronger will be the teas. The operation of rolling is simply for the purpose of breaking or bruising the numerous diminutive cells of which the leaves are constructed, in order to induce chemical action to take place, the resultant of which is the product called tea; but how this arises I am unable to state, neither is it of the lightest practical importance to the manufacturer. Old tea planters believed that the rolling was solely for the purpose of extracting the acrid juices from the leaves, but a moment's reflection should convince any one that it is these very juices which are contained in the cells and their interstices that makes the tea. To look at the matter in an extreme point of view, supposing the entire fluids were removed from the leaves during manufacture, there would remain nothing but the bare skeletons to be put into the pot, and consequently the boiling water could extract no tea from these suitable for the table. Rolling for a longer time than experience dictates, although lightly, is as detrimental as the converse.

The Oldest Planter in India.

If you roll lightly you will have a better show of tips, but then on the other hand you stand a chance of not getting all the juice cells in the leaf bruised, and the consequence is, want of strength in the tea. I think, as the market stands at present, liquor is the test, and there is nothing like heavy rolling to bring out the strength. I am inclined to think that, provided the first roll has been thoroughly done, there is no advantage in giving a second, besides with a single roll you can easier attain the much-desired salmon colour in the infused leaf.

An Authority.

The object in *Balling* is to fix the twist of the leaf, so I say ball when the roll is finished—do not open out until just before placing on the trays. Re-rolling is a mistake.

An Assam Planter.

The absence of the pungent malty flavor which used to characterize Assam teas in former years must be owing to the more general use of rolling machines now. I believe the action of the pieces of the leaf on the iron used in most rolling machines forms compounds (tannate of iron), which being diffused though the tea hides or spoils its flavor, making it coarse and flat instead of fine and pungent. Now that the action of the iron on the leaf has become known, and steps have been taken to prevent the leaf coming in contact with the iron used in the making of tables, I have no doubt the teas will be found having the same fine flavor which they used to have when hand rolling was only employed.

CHITTAGONG PLANTER.

I HAVE often made the experiment against lightly rolled leaf, and find that the heavier the leaf is rolled the stronger is the tea. I am referring to hand rolling. The latter process however discolors the tips and gives a larger proportion of broken. I think the mass should not be re-rolled or in any way disturbed during process of fermentation. I spoilt my teas for a time by heavy re-rolling before firing, and now merely open out the balls to spread on the firing chalnies.—*Indian Tea and its Manufacture.*

FERMENT.

AMONGST organic compounds there exist a number of substances, some of animal, others of vegetable origin, containing nitrogen, and in which the different constituents are held together by affinities so feeble, as to render them liable to spontaneous changes when exposed to favourable conditions, such as air, moisture, and warmth. Albumen, fibrin, casein, and gluten, for instance, are bodies of this class, which, when removed from vital influence, are exceedingly prone to enter into slow chemical decomposition, the final products of which are usually carbonic acid, water, and ammonia. Such substances during their passage through these chemical changes are termed *ferments*, and are capable of inducing, by mere contact with other bodies of more stable character, certain chemical changes. This operation of inducing chemical change by contact with a ferment is denominated *fermentation*, and is frequently employed both in chemistry and the arts for producing various interesting transformations. It is thus that alcohol is produced from sugar by the ferment yeast; the peculiar oil to which mustard owes its origin is generated by a similar reaction; and recently Berthellot has succeeded in transforming glycerine into grape-sugar by mere contact with a small fragment of animal membrane. As a ferment is essentially a body in a state of chemical change, it follows that the exact composition of such bodies is difficult, if not impossible, to determine, and hence we are unacquainted with the formula of any ferment. The following are the best known ferments:—

1. *Yeast*, produced when a saccharine solution, containing nitrogenous matter, as white of egg, is exposed to the air at a temperature of about 80° Fahr. The yeast separates as a kind of scum or froth. It transforms sugar into alcohol and carbonic acid, malic acid into succinic, acetic, and carbonic acids, and tannic acid into gallic acid.

2. *Diastace.* This ferment exists in malted barley, and possesses the property of converting starch into dextrin and grape-sugar

3. *Synaptase* or *Emulsin* exists in almonds, and converts amygdalin into oil of bitter almonds (*hydride of benzoyl*), formic acid, hydrocyanic acid, and sugar. [AMYGDALIN.] It also converts salicin into sugar and saligenin. According to Thompson and Richardson, when synaptase is boiled with caustic baryta, it yields *emulsic acid.*

4. *Myrosin*, contained in mustard. In contact with water and myronic acid, which is also contained in mustard, it produces oil of mustard.

5. *Decaying cheese*, in contact with cane or milk-sugar, transforms them first into lactic acid, and then, by further contact, converts this lactic acid into butyric acid, carbonic acid, and hydrogen. The latter transformation is sometimes termed the *butyric fermentation.*

It must be remarked that all these fermentive processes require the presence of water and moderate warmth. They are frequently, but not invariably, attended with the evolution of gases. In many fermentive processes, the ferment itself suffers very little change, although large quantities of the fermentescible substance may have undergone transformation. The ferment does not, therefore, combine with any of the products of transformation; it appears only to communicate, by contact with the fermentes-

cible substance, an impulse to the molecules of the latter, which determines their splitting up into two or more new compounds.

Processes which are generally regarded as analogous to the above, but which are less understood, can be induced in the bodies of living animals; thus when morbific matter, the fluid of putrefying flesh, vaccine matter, &c., are brought into contact with circulating blood, the latter suffers remarkable changes, attended with the production of certain forms of disease; and it is also more than probable that gaseous ferments are amongst the conditions necessary for the production of most, if not all, infectious diseases, such as typhus, cholera, scarlatina, &c.—*English Cyclopædia.*

FERMENTATION OF TEA.

WHAT IS IT?

I.—BY CHAS. H. LEPPER.

PLANTERS know that "fermentation" softens down and deadens the liquor, and that if they "ferment" highly, they cannot help depriving their tea of much of its "rasp." They know that if their teas are intended for mixture with Chinese teas, they must "under-ferment" and obtain full strength and pungency, whereas, if their teas are intended to be sold alone, they know such "under-fermentation" would render them undrinkable, and that, in consequence, they must "ferment" to a considerable extent to overcome the too harsh character of Assam growths. Coming to the brokers' test of "fermentation," *viz.*, the colour of the leaf after infusion, they know that—

1*st.*—In the beginning of the season, when the weather is cool and the air and soil comparatively dry, and the sap cannot, from its absence, be expressed in the rolling process, they know, or say have noticed the fact, that the desirable "light salmon colour" is hardly procurable save to those who "know a dodge or two." That, instead, they find the leaf assumes a dark olive colour (actually often reported on as "over-fermentation!"), which is both ugly and very undesirable.

2*nd.*—They will have noticed that on hot dry days, after a period of drought in the hot weather, the balls put to "ferment" by those who go in for balling, assume a black appearance on the outside, and may be quite "unfermented" in the inside.

3*rd.*—That once the leaf is put over hot fires "fermentation" ceases.

4*th.*—That the sign of "over-fermentation" is a darkened or dark copper colour appearance on the infused leaf; *not* a dark olive, as given in note!

5*th.*—That "excessive fermentation" results in the leaf going sour before it is put on the fires; to avoid which, the leaf is often put on the fires and half-cooked to check fermentation, and then taken off till all the day's tea is so checked; and finally finished off when all the day's leaf has been half-fired.

6*th.*—That the interiors of the balls in the process of "fermentation" undoubtedly heat and generate a gas or gases, probably carbonic acid mixed with other ingredients. Carbonic acid gas has no smell, and this gas or these gases has or have a strong smell.

7*th.*—That "fermentation" requires sap in the rolled leaf, warm atmosphere, and pressure and contact, to ensure evenness and rapidity, and that the leaf exposed to the air and light, *unless* the "fermentation" is going on rapidly from the interior, as under favourable conditions of sap and weather, becomes of a darker and green olive than the interior, which may be properly fermented and of the proper colour.

8*th.*—That to produce this "fermentation," the leaf must previously have been rolled, or say macerated, to express the sap and bring about conditions suitable to the chemical action that it is desired to set up,—call it "fermentation" if you will.

Before I go any further, let me say that I am most certainly not writing with any intention of *giving* information, save only in so far as this letter may produce intelligent replies from more enlightened sources. I am no chemist, and am asking for information. As there are no chemists that I know of acquainted with the process of tea-manufacture, I have thought it best to put the process of so-called "fermentation" in a definite shape before such chemists as may feel interested, and choose to enlighten us as to what really does take place during the process.

From all the planters that I have asked

notwithstanding they employ the process daily, and have noticed all the facts above detailed, I have not been able to get any answer to my question of "What goes on?"—"Suppose it's fermentation;" and there it ends! It appears to me that scientific men hearing practical planters, merchants, &c., speak so decisively of "fermentation," have never doubted that fermentation does go on, not having themselves seen the process; and hence our present erroneous term for the process.

It is clearly *not* fermentation for several reasons, nor is it oxidisation, for the reason that the oxidised leaf is the olive-coloured leaf, in distinction to the salmon coloured, and found to prevail on days when "fermentation" is slow owing to unfavourable weather, &c, and the leaf is long exposed to the air; the oxidised leaf, judging by this test of colour, is found on the *outside* of balls or heaps undergoing the process, and is chiefly quite different from the reddish brown, or dark copper colour caused by "*over-fermentation.*" If I might hazard an opinion in advance, I think it will be called a modified form of spontaneous combustion, and this is brought about by the macerating process, which, by expressing the juice and disruption of particles, accelerates decay, and with heat generates gas or gases just as in the case of a hay stack that has been stacked when damp.

I believe that real fermentation *could not* set in, in the time and under the conditions now allowed for the process. It must be remembered that the leaf is often, in suitable weather, quite sufficiently "fermented" in three minutes, and as much so as, under unfavourable circumstances, might take an hour! Is it possible that fermentation can set in in three minutes—and that without the addition of its germ or germs, save in so far as it or they might be attracted from the atmosphere,—there being no foreign water added to the natural juice, or brought in contact with the leaf?

Were the leaf spread thin without being rolled or macerated, without any expression of juice, decay would *follow* oxidisation, not *precede* it, as it precedes it in our process, and would of course be a lengthy process in comparison; and would certainly totally unfit the leaf for manufacture. I am inclined to think decay setting in *before* oxidisation; accelerated by the assistance of water (the free juices), sets up a violent chemical action accompanied by the phenomenon of heat that, being allowed to go certain lengths without going too far, affects the tanning in the leaf and softens thus the liquor as the result.

This leads me to believe that the leaf after rolling should not be allowed to remain about, scattered thin, or with a large quantity or say surface of a heap, exposed to the air, as being likely to produce oxidisation instead of decay, *i.e.*, the olive-green instead of the salmon colour, and the more of the former there is, the more uneven the "fermentation" will appear of course.

The only thing I can advance against my theory in practice is, that hot, damp air dispersed through rolled leaf on cold dry days, when there is also a want of sap, and "fermentation" happens to be slow and unsatisfactory, produces quick and even "fermentation;" yet I doubt if this does not rather endorse my theory than otherwise. For instance, might not the previous macerating or rolling process have so started the particles on their way towards the "stable equilibrium" of inorganic compounds, that when damp heat is added, the process goes on quicker than oxidisation can set in, notwithstanding the dampness of the air, which dampness is necessary to prevent the drying up of the scarce sap, and thereby stopping of the process of decay.

We know that heat assists chemical action by increasing the distance between the centres of the particles, and that water assists by diffusing them: hence a deficiency of either will act as a check on a process depending on chemical action; hence the tardiness in decay on cold, dry days is aggravated when there is also a want of sap, this tardiness sometimes being so protracted that oxidisation sets in the first of the two, and the olive-green appearance is the result, which once obtained the whole process seems affected, as the salmon-colour will never come to the leaves so oxidised, and it is useless waste of time waiting for it.

Although I have here advanced a theory in order to create discussion, I am quite open to conviction, and shall be only too glad to be corrected if wrong, as, whatever this process may be, be it fermentation, or be it rot, I am quite alive to the importance of having it under command by understanding thoroughly its real principles.

II.—By Chas. E. M. Russell.

Mr. Lepper writes under the above heading, asking for a chemical explanation of the organic metamorphoses which take place after the plucking of the leaf of tea, and which are commonly and collectively designated under the title '*fermentation*,' the propriety of which term, as applied to

the changes taking place in rolled leaf of tea, Mr. Lepper is inclined to question.

As far as my limited knowledge of the subject will carry me, I see no reason whatever to doubt the propriety of the term, for the primary processes necessary to the fermentation of all fermentable matter do undoubtedly take place in the leaf of tea after rolling, though they are checked before true fermentation has been effected. Mr. Lepper is quite right in supposing that the change of color which takes place is one of the symptoms of incipient decay: but, then, what else is fermentation?

While an animal or vegetable organism is possessed of the mysterious and indefinite principle which we term *Life*, it can undergo in its structure only such chemical changes during health as are appointed by nature for its well being: should any external or internal cause give rise to an altered condition, disease, and ultimately death, will be the result. As soon, however, as death ensues in the whole or a part of any such organism, the chemical changes incident to decay at once commence to reconvert its whole or the part thus visited into the earth and air from which they had their origin.

In the operation of rolling, the *cellulose* which forms the skeletons of the leaf-fibres is fractured and thoroughly brought into contact with the expressed sap contained in the leaf,—now a dead vegetable product, with its parts more or less disintegrated and exposed to the oxygen of the atmosphere.

Now, the sap of plants contains dilute acids as well as alkalies in solution, and *cellulose* is soluble in dilute acids and alkalies.

The first chemical change that takes place is the conversion of the cellulose (which is identical in chemical composition with starch) into *glucose* or grape sugar. The chemical formula showing this change is—

$C_6 H_{10} O_5 + H_2 O = C_6 H_{12} O_6$

Cellulose + water = glucose or grape sugar.

At this stage a high temperature and an expulsion of water by heat will stop the process, which, if it be allowed to proceed further, will, by a change set up by vegetable spores, ever present though invisible in atmospheric air, further convert some of the *glucose* into *alcohol*, the chemical formula being—

$C_6 H_{12} O_6 = 2 C_2 H_6 O + 2 CO_2$

1 of glucose = 2 of alcohol + 2 of carbon dioxide.

The conditions necessary to fermentation are *heat* between certain degrees, *moisture* and *oxygen*.

Fermentable liquids, unless exposed to the action of air containing *oxygen*, will not ferment. The ranges of temperature between which fermentation takes place most readily are 20°–40° C. Hence the influence of the temperature in effecting rapid or slow fermentation, as the case may be.

In the baking of bread and in malting we have familiar instances of the changes above-mentioned. In the former the lightness of well-baked bread is due to the evolution of the carbon-dioxide gas formed with alcohol from the glucose, which is itself formed from the starch contained in the flour. In malting, the change of starch into sugar is well marked; for the manufactured malt contains *four times* as much sugar as is found in the raw grain of barley.

If inexperience does not lead me into error, I should imagine that the object of fermentation is to effect this conversion of *cellulose* into *glucose*, and that the process should be stopped before there is any danger of the *glucose* thus formed being metamorphized into *alcohol* and *carbonic acid gas*.

The sweet smell of fermenting leaf is evidently due to the *glucose* which has been formed, and I have somewhere heard or read, the smell in the tea-house when tea has been over fired or burnt, compared to the odour emitted by burnt sugar. I hope that this explanation may not be adjudged untenable by himself or by others.

III.—By Chas. H. Lepper.

Permit me to thank Mr. Russell for his kind reply to my question as to—What is "fermentation"? Though his intention was kind, it was still kinder in its result than he appears to quite realize; *thus*, it is the very best endorsement of the view I ventured to hazard in my first letter that I have yet seen! His facts and statements are all I required, as coming from a defender of the "fermentation" theory, to give me greater confidence in my suggestion, that "fermentation" is the *wrong* word to use for the *process* we are considering. Do not think me rude if out of his own mouth I must convict him to make a point that is quite admissible in fair argument. Thus he says, "Mr. Lepper is quite right in supposing that the change of colour which takes place is one of the symptoms of incipient decay: but, then, what else is fermentation"?

Exactly; that is just what I ask! and he tells me later on as I will show; but here is a concession I cannot help taking advantage of in passing. Let us follow out the assumption :—

"The change of colour which takes place is one of the symptoms of incipient decay." Now let us disentangle cause from effect.

Cause : incipient decay.

Effect or Symptom } = "change of colour."

Thus Mr. Russell appears to agree with me, that the cause of the change of colour *is due* to incipient "decay"! But he puts a rider to this, and says that "incipient decay is fermentation," as his question is evidently of the nature of an assertion. According to this I am not in error, as things which are equal to the same thing are themselves equal—I have not opened my Euclid for many years, so excuse free quotation—this is, supposing that Mr. Russell's assertion be correct, *viz.*, that fermentation and our *process* under dispute are the same thing. But I have reason to doubt this from Mr. Russell's own showing in a later part of his letter. Thus let me change the order of his sentences, promising not to change their intended meaning thereby, but simply to result in a different conclusion.

I must presume, however, that where I put *fermentation* thus in "ITALICS," he uses it in the present conventional manner as applying to *our* process under discussion, and not to theoretical fermentation.

To proceed,—

"The first chemical change that takes place is the conversion of the *cellulose* into *glucose* or grape sugar. The chemical formula showing this change is—

$C_6 H_{10} O_5 \times H_2 O = C_6 H_{12} O_6$

Cellulose × water = glucose or grape sugar. I should imagine that the object of 'FERMENTATION' is to effect this conversion of *cellulose* into *glucose*, and that the process should be stopped before there is any danger of the glucose thus formed being metamorphized into *alcohol* and *carbonic acid gas*. At this stage (before there is any such danger) a high temperature and an expulsion of water by heat will stop the process, which, if it be allowed to proceed further, will, by a change set up by vegetable spores ever present though invisible in atmospheric air, further convert some of the *glucose* into alcohol!! The sweet smell of 'FERMENTING' leaf is evidently due to the *glucose* which has been formed"!

Then, what more proof do I want? If Mr. Russell dislikes my liberty in thus arranging his sentences, and denies their paternity under the circumstances, put them down to me and call them mine, I am *grateful* for the weapons.

He distinctly shows that he advocates stopping the process *before* fermentation (real) has began, *i.e.*, *before* the spores *begin* their work, when the sweet smell which is a recognized criterion of "FERMENTATION" *warns* us that the process of converting $C_6 H_{10} O_5 \times H_2 O$ into $C_6 H_{12} O_6$ is complete, and tells us to check this stage of decay FOR FEAR of fermentation (real) setting in!!

Thus then his first assertion that *incipient* decay and fermentation are convertible terms, is disproved by his own showing, as real fermentation is the second stage according to Mr. Russell, and I accept his showing coming from him. Further, then, our process being, according to Mr. Russell, the *first* stage *before* fermentation has *began is incipient decay* or *Rot*, and "FERMENTATION" as applied to our process is a conventional term of *no value* as correlative to the *real* facts! Q. E. D.

One more quotation from Mr. Russell's letter. He says, speaking of "fermentation" as being the proper name for the process under discussion, "I see no reason whatever to doubt the propriety of the term, for the primary processes necessary to the fermentation of all fermentable matter do undoubtedly take place in the leaf of tea after rolling, though they are checked *before true fermentation has been effected*." The italics are mine. In reply I would ask your correspondent, would he be content to accept a lump of dough from his baker because the latter chose to call it "bread" by the same process of reasoning? I imagine not! Then why call the process "fermentation" with just as little justification?

IV.—By B. H.

A MOST important part of the manufacturing process, but a difficult one to understand and control, and rather a dangerous subject to venture any very decided opinions upon in the present state of our knowledge of it. To any one not keenly interested in it, the subject is a very dry and abstruse one to read up, but to anyone who wishes to study it I would recommend Dr. Schutzenberger's book on fermentation, being Volume XX. of the International Scientific Series, from which may be gathered information on some at least of the points of the subject, though the treatise has no special reference to tea in any way, but deals with the subject of

fermentation generally. According to the latest researches, fermentation is the term applied to express the temporary disturbance of equilibrium in the component parts of compound substances in which, under circumstances favorable to their development, certain inferior living organisms, called ferments, are engaged in abstracting and assimilating the oxygen contained in those substances, and in setting free an equal quantity of a gas known as carbon dioxide. The minute germs of some one or other of these ferments are supposed to be ever present on the surface of all fruits, and, as I infer, on tea leaves also, ready to take immediate advantage of a rupture in the cellular tissue to make their entry and fulfil the end of their existence by increasing and multiplying therein.

As far as I can make out from the book I have quoted, this is "what goes on" during the process which we call fermentation, but we are all much in the dark in this matter, and if a *competent* chemist could be found, it would be well worth the while of tea owners to engage him to investigate the matter with patient study, with a view to our being able to get it more within our knowledge and control than it is at present.

V.—By Simplicity.

The process in the manufacture of tea which we rightly or wrongly call Fermentation is so important, and demands so much of the planter's care and attention, that I am sure a few remarks will be read with interest.

I propose, in the first place, considering what real fermentation is, and in the second, whether it is either possible or probable that Real Fermentation can take place in the manufacture of tea.

The researches of the eminent French chemist, Pasteur, lead to the following conclusion regarding fermentation:—

Fermentation is produced by the action of living germs or cells on the substance to be fermented. These cells or germs may be of three kinds:—

1st.—The living cells which exist inside fruits.

2nd.—The germs or seeds of plants.

3rd.—The germs of animalculæ.

In the first instance what takes place is this: The cells take oxygen from the saccharine juices of the fruit, throwing off carbonic acid and producing alcohol. If these cells are broken or injured by gushing or other means, they are powerless to effect this. Everybody knows the unpleasant hot flavor of a pine-apple that has been kept too long. It has lost its sweetness, and has acquired instead a peculiar burning taste. What has taken place is neither more nor less than fermentation. The living cells which exist in the pulp of the fruit have absorbed oxygen from the sweet saccharine juices, and have by doing so produced alcohol, which is the cause of the burning taste.

The second instance arises from a very different cause. We now have the germs or seeds (as they really are) of a plant acting exactly in the manner I have described in a foreign substance. This is the sort of fermentation that comes into play in the manufacture of Beer and Wine. The brewer first steeps his barley for a certain time in water, then drains and subjects it to a gentle temperature sufficient to cause it to germinate; he then dries it on a kiln and calls it *Malt*. He now grinds and mashes it up with warm water, boils it with hops until all the soluble parts have been extracted, and obtains an infusion which is called *Wort*. He has now got to ferment this, and for the purpose uses the seed of a minute plant called *Torula cerensiæ*. Yeast is a fluid containing these seeds in suspension, and the admixture of the yeast with the wort is simply the sowing of the seeds of the Torula in a congenial soil. These seeds sprout and grow, but in order to do so they require oxygen. They accordingly take it from the sugar contained in the wort, turning it (the sugar) at the same time into alcohol, and acting just in the same way as the life-cells did in the case of the pine-apple. In the manufacture of wine, yeast is not required, simply because the seeds of the Torula are found on the outer surface of the ripe grape ready to hand. Break the skin, and the seed is sown, and 48 hours afterwards we find it sprouting into growth with all the usual phenomena of real fermentation.

The result of fermenting *wort* with Torula is the glorious beverage called *Beer*. The result of fermenting the *Must* of the grape with the seed of the same plant is *Wine*. Were germs of other ferments sown in the wort or *must*, fermentation would ensue, but the results would not be palatable. The maladies of beer are owing to its being contaminated by germs floating in the air which are not those of the Torula. The plants which spring from these objectionable seeds are not nourished in the same way as the Torula, and consequently the result is not *Beer*.

The third instance is that in which the germs or eggs of animalculæ are sown:

in short, when animal and not vegetable life is the fermenting power. When milk turns sour or putrefies, the cause is to be sought in the presence in it of curious eel-shaped organisms: the sourness being due to an animalculæ called *Vibrio*, and the putridity to a different one called *Bacterium*. These animalculæ float in the air, and are the direct cause of milk going bad. Keep your milk in air free from them, and it will never go sour or putrefy. Take a common tin of soup, open it and leave it exposed to the air in your room; it will putrefy in a certain period, which will be longer or shorter according to the temperature of the atmosphere. Now open a similar tin in air which you have freed from such germs, and it will remain for ever perfectly pure. The Bacterial eggs which float in the air of your room fall into and are hatched in the soup. They then breed and multiply at a marvellous rate, totally altering the composition of the soup; and the result is putrefaction as it is commonly called, which is really due to fermentation.

We thus have three phases of Fermentation. In all three the casual force is to be found in the *life* existing in cells or seeds or eggs, and the question is—does any such process take place in the manufacture of tea? In the first case alcohol is produced, and we may therefore dismiss it. The third instance is wholly inapplicable—and we have only to consider whether the second meets the phenomena of the case. Your correspondent "B. H." thinks it likely that germs, such as are found on the outer rind of fruit, may be supposed to be found also on the leaves of tea bushes. I don't think it follows at all that because fermenting germs are found on fruit, they are also certain to be found on leaves, and, if it is the Torula he refers to, he is certainly wrong; as that plant produces alcohol, and no trace of anything of the kind, as far as my knowledge goes, has ever been found in tea (worse luck !). But even if germs did exist on the leaves, the question can be set at rest for ever by simply placing a freshly-rolled leaf under a powerful microscope, which will soon tell whether any life, either in the shape of cell, plant, or animalculæ, exists on it.

Now that I have told you what "*Fermentation*" is not, I will give you my opinion as to what it is, but I don't claim more for it than a mere conjecture.

I think that something of this kind may turn out to be the solution of the mystery:—

The process of rolling expresses the juices of a leaf, and among them appears *Tannic acid*. Fire your leaf immediately after it is rolled, and after infusion note flavour of liquor and color of out-turn. The liquor tastes harsh, pungent, and raspy, and is quite unpalatable. It further wants "body." Compare this with leaf that has been fired after being just sufficiently "*fermented*," and then with leaf that has been allowed to "over-ferment" before being laid on the trays. It is quite unnecessary to enter into particulars, as they are familiar to everyone.

But what are the causes of the differences in the flavours of the liquors and colors of the out-turn. I reply that the causes are one and the same, namely, *Tanic acid*. In the first case the acid has not had time to combine with the other juices, &c., or to tan the leaf: in the second case, it has had time to do so to a certain extent; and in the third, it has been allowed to do so too much. In the first case we taste the acid in excess. In the second, just enough, and in the third, too little. "*Rasp*" is due to free acid; "*body*" to combined acid. Over "fermented" tea cannot possess "rasp," nor can what is under "fermented" possess "body." This explanation seems to be too simple to be true, but whatever it is I think I have shown that it can't be Fermentation.

REFERRING to the remarks on Fermentation by "Simplicity" would he kindly oblige me by explaining the authority on which he bases his assertion that "yeast is a fluid."

In Dr. Schützenberger's book, which is the best authority on the subject that I know of, we meet with such expressions as *Dry* Yeast, *Dried* Yeast, *Damp* Yeast, Yeast *Dried*, *Grains* of Yeast, and so on, which are evidently applicable to solids, not fluids—hence my request.

I find several other queer and startling things in your correspondent's letter, but they are more in the way of implication, inference, or reduction, and therefore do not challenge discussion quite so much as the bold *assertion* that "Yeast is a fluid"—with proof of which I will be satisfied for the present. As he says he has no knowledge of alcohol having ever yet been found in tea, allow me to introduce myself to him and others in the like state of blissful ignorance, as

ROBUR,
The Tea Spirit.

ALLOW me to thank your correspondent "B. H." for his kind attention and reply, and at the same time to express my regret that he did not enter a little more into detail, as I can hardly follow his line of argument out to the conclusion he wishes to point to: *ex. gr.*, he says: "Fermentation is the term applied to express the temporary

disturbance of equilibrium in the component parts of compound substances in which, under circumstances favorable to their development, certain inferior living organisms, called ferments, are engaged in abstracting and assimilating the oxygen contained in those substances, and in setting free an equal quantity of a gas known as carbon dioxide." Good, but this predicates "a *temporary* disturbance of equilibrium," and "favorable circumstances;" these require demonstrating, as it may be said, if "fermentation" is left to itself in tea, under favorable circumstances, it would go on until the stable equilibrium of all the parts had been reached, and this can *hardly* be called "temporary disturbance," in the sense understood, since it would mean a total revolution amongst the component parts, *ending* in as many separate elements as the parent mass originally could boast of! Again, as to the favorable circumstances your correspondent speaks of, let me take this with what he says further on, *viz.*, "the minute germs of some one or other of these ferments are supposed to be ever present on the surface of all fruits, and, as I infer, on tea leaves also, ready to take immediate advantage of a rupture in the cellular tissue to make their entry and fulfil the end of their existence by increasing and multiplying therein." If *all* leaves are thus provided, with their leaven, so to speak, then why do the leaves in the *centre* of tightly-pressed compact balls of rolled-leaf, develop to the necessary degree sooner and better than the leaves on the outside of the ball which have undergone precisely the same process as those of the inside? Why, if merely a rupture of the cells is necessary in theory, should *heat* be also necessary in practice? Of course the more sap the more oxygen; but why the heat? What colours the leaves? Are they stained? If so, what causes the olive-green stain, and what the salmon-colour? Would carbon dioxide stain the leaves? What causes the phenomenal heat in the balls of rolled-leaf? I don't mean the frictional heat from the rolling process.

Fermentation and rot can and do go on together alongside of each other, but I am still not convinced that we cannot have *rot without* the fermentation, whatever the latter may be, in the process of tea manufacture here discussed.

That rot, or say chemical action, *does* go on I suppose no one will dispute, and that alone could produce the phenomenal heat, and could stain the leaves. Now, if the staining of the leaves is to be attributed to chemical action, which at the same time produces another effect on the liquor, then this is exactly our object in the process in question. Then if our object is obtained thus by chemical action (*quod est dem.*), and *not* by fermentation, supposing fermentation *does* take place alongside of the chemical action, why should we call the process "Fermentation," when that is merely Rot's twin-sister's name?

The severe friction to which the leaves are subjected by machinery places tea "fermentation" almost outside of comparison with fermentation in *pressed* matter. Such friction as tea undergoes is quite sufficient in certain states of the weather to produce a very considerable quantity of electricity; here is *possibly* another factor waiting to be taken into account! Altogether, as your correspondent "B. H." very pertinently remarks, "we are all very much in the dark in this matter, and if a *competent* chemist would be found, it would be well worth the while of tea-owners to engage him to investigate the matter with patient study, with a view to our being able to get it more within our knowledge and control than it is at present."

C. H. Lepper.

I have received your issue, which contains Mr. Russell's letter on the subject of "Fermentation," and wish to make a few remarks in criticism of the theory which he propounds. This is what I understand he imagines to take place:—

I.—The rolling fractures and smashes up the skeletons of the leaf-fibres.

II.—Which are thus brought in contact with the sap.

III.—The skeletons are composed of cellulose and the sap of acids and alkalies, and the former is dissolved by the latter.

IV.—The cellulose takes water from the sap, and forms with it glucose.

And at this point Mr. Russell supposes the leaf to be put on the trays and the process to conclude. I must say I cannot accept the explanation as the satisfactory solution of the question.

In the first place, the skeletons of the fibres are not much fractured by the process of rolling *if properly conducted* (take a sample of leaf rolled by a "Kinmond's Improved," or better still by hand, and you can at once convince yourself of the truth of this.) and consequently are not in fit condition to be dissolved by the acids and alkalies contained in the sap. At all events a powerful microscope will soon tell us whether the skeletons are affected or not, in whole or in part by the process. In the second place, Mr. Russell's theory does not dispose of the acids and alkalies contained in the sap, and which I am sure every planter will bear me out in considering the really important constituents. I am clearly of opinion that what takes place is an inter-combination of these acids and alkalies, modified by oxygen received from the air; or, in other words, a return of organic combinations to the stable equilibrium of inorganic compounds. Unless we suppose the acids and alkalies of the sap of tea leaf to come into play, we are logically bound to

admit that *any* leaf, if only properly manipulated, would do to make "*Tea*" of.

But if Mr. Russell's theory of what we *call* "Fermentation" is open to criticism, his account of what takes place in real fermentation is much more so.

He says (1), that if the glucose, which he supposes to have been formed, is exposed to the air, and therefore to the vegetable spores contained in it, some of the glucose will be converted into alcohol; (2), that the conditions necessary to fermentation are *heat* between certain degrees, *moisture*, and *oxygen*; (3), that fermentable liquids, unless exposed to the action of air containing *oxygen*, will not ferment. Now, there are lots of spores floating about everywhere, but among them are rarely found those of the alcoholic ferments. The worthless spores or seeds would of course set up a fermentation of some kind, but the effect would *not* be to change the glucose into alcohol.

Again, the admission of oxygen to a liquid undergoing fermentation (real) is to stop it. It is a fundamental point in the conduct of fermentation that oxygen should be excluded.

If the growing Torula can get its oxygen from the air, it won't take it from the sugar in the liquid, and no alcohol, or at least a very minute quantity, will be formed. If, on the other hand, the supply of air is cut off, the oxygen necessary for the growth of the plant is forcibly taken from the sugar which is reduced to alcohol precisely in accordance with Mr. Russell's formula $C_6 H_{12} O_6 = 2 C_2 H_6 O + 2 C O_2$.

The carbonic acid gas being breathed out by the plant, and the oxygen which enter into its constitution being taken from the glucose, I need hardly now point out that it is incorrect to suppose (3) that fermentable liquids, unless exposed to the action of air containing oxygen, will not ferment. It is the exact opposite.

In conclusion, as I pointed out in my last letter, and have mentioned in this, a good microscope in the hands of a skilful observer will set this matter, as well as many others like it, at rest. SIMPLICITY.

WITH regard to the letter signed "Simplicity," the criticisms therein indulged by my anonymous antagonist are quite unworthy of any reply, since the author informs that "the admission of oxygen to a liquid undergoing fermentation (real) is to stop it. It is a fundamental point in the conduct of fermentation that oxygen should be excluded."

I have pleasure in making a brief reply to another letter from the pen of Mr. C. H. Lepper. Mr. Lepper objects to the use of the term *fermentation* as applied to the chemical changes which take place in the leaf of tea during the interval allowed to elapse between the processes of rolling and firing: Mr. Lepper would prefer the use of the term "Rot," and his arguments, as well as his remarks upon my own letter, are logical and fair enough.

In case of my former letter on that subject containing any ambiguous phrase, I will once more briefly give him my views upon the subject:—

(1). "Rot" when perfected has been brought about by a number of chemical changes, of which fermentation is but one.

(2). The "*fermentation*" of tea is the natural process by which the first step of fermentation (real) is effected.

(3). Considering that the first act of fermentation (true) does in reality take place in the process under discussion, the term "fermentation" does in fact describe that process more nearly than any other at present in use.

The term "Rot" is altogether too general a one: there may be "Rot" without fermentation, whereas fermentation is one of the natural processes which jointly and collectively consummate in producing the elaborate result termed "Rot."

A synonym for the words "*incipient fermentation*" would doubtless be the most correct term which could be employed for the so-called, (and in my opinion rightly-called) "*fermentation*" of tea, which is not true and complete fermentation, inasmuch as the second stage of the process is not, or ought not to be, allowed to develop itself; but in so far as the first stage of true fermentation is of a surety essential to the manufacture of good tea, I shall, until some better name be found for it, continue to maintain the propriety of the term "*fermentation*" as applied to the process commonly so called which takes place in the leaf of tea after rolling.

CHAS. E. M. RUSSELL, M.R.A.C.

IN a letter from Mr. Chas. E. M. Russell, he remarks on my criticism of his theory of the "Fermentation" of tea, and on the theory proposed by Mr. Lepper. He sets down my objections to his opinions as unworthy of reply, inasmuch as I assert that "the admission of oxygen to a liquid undergoing fermentation (real) is to stop it. It is a fundamental point in the conduct of fermentation that oxygen should be excluded." The theory of Real Fermentation advocated by me is no original idea of my own. It is, on the contrary, the grand theory brought to light some time ago by the eminent French chemist, M. Pasteur, who is one of the greatest living authority on such subjects; and I may add that M. Pasteur's theory is supported by perhaps the best and most successful experimenter in natural science of the present day. I refer to Professor Tyndall. M. Pasteur has discovered that the conduct of Alcoholic Fermentation, such as is caused by the *Torula cerensiæ*, depends on that

plants being obliged to obtain the oxygen required for its growth from the sugar contained in the liquid to be fermented instead of from the air; and that *unless the air be excluded, no fermentation worth speaking of will take place.* Every one who has the smallest claim to being considered an authority on the subject, is aware of this theory. Mr. Russell does not seem to know of this theory when he states that "oxygen is necessary to fermentation." This matter is just now particularly engaging the attention of planters, and I have frequently taken the opinions of men whose experience is considerable, and I can assert that for the last 3 years I have not met a single planter who did not deride the idea that the change which takes place in leaf, after being rolled and before being placed on the trays, had anything whatever to do with *Fermentation.* When Mr. Russell asserts that it has, he supports a theory which in no way accounts for the phenomena of the case. Will he tell us why under-fermented tea gives a pungent, raspy liquor, while that of over-fermented tea does not possess those qualities? His theory explains nothing.

I have no hesitation in repeating the assumption which I ventured to make. I feel convinced that the presence or absence of free tannin acid in the liquor is the cause of its being raspy and pungent or the reverse. The longer the leaf is left without being dried, the less uncombined acid will be found in its liquor; while leaf that is dried off quickly after being rolled yields a liquor, the flavour of which would seem to point to the fact of its containing a large quantity of free acid.

The term *Fermentation* as applied to the process in question is unfortunate and misleading. SIMPLICITY.

A CORRESPONDENT writes: "The colour of the new penny may be had equally well by oxidation as by fermentation. Fermentation softens the pungency wanted, then why ferment? No one can tell whether the tea has been oxidized or fermented when it has the desired colour. The sap does not mature in the leaf till the beginning or middle of May, whether the bushes have been late or early pruned"

There is some obscurity about the above, but I gather from it that your correspondent considers fermentation to have a twofold result, in that it "softens the pungency" and gives "the desired color" to the tea. I admit that it lessens the astringency of the liquor—indeed care is necessary to avoid overdoing it and making your tea too "*soft*"; but I am not so sure about the other point. I think the color of the infusion depends greatly upon the following six important matters, each of which affords scope for careful study and experiment before we can consider them to be thoroughly or even sufficiently understood, *viz.*:—

(1.) The variety of the plant.
(2) The quality (age) of the leaf.
(3.) The condition in which it was gathered and brought in (wet or dry).
(4.) Mode and extent of withering.
(5.) Pressure under which it is rolled.
(6.) Time occupied in rolling.

There may also be other things influencing or effecting it, but I think those who look into the matter studiously will soon convince themselves that *fermentation* has less to do with the color, *in cup*, than is generally supposed. I have found that good leaf cleanly kept, carefully handled, and promptly manipulated, gives a beautiful color with a very slight degree of fermentation, whilst leaf of an inferior quality, or less carefully treated, throws a paler infusion though fermented *ad libitum*. Fermentation is a subject regarding which we all, I think, have much to learn before we can be said to have anything like fixed principles for our manufacture.

Your correspondent says, "the color may be had equally well by oxidation as by fermentation, then why ferment?" Will he favor us with a description of the two processes, pointing out what he considers to be the difference between them. And I should also like to know what is the meaning, object, or connection, with the particular point under discussion, of his last sentence, "the sap does not mature in the leaf," &c.

Before closing, I am induced to add a word or two in reference to the drying machines now being introduced by Mr. Jackson and others to supersede the system of open charcoal fires. It is claimed for these machines that fermentation stops the moment the leaf is put into them; whilst under the old process it goes on for some time after the leaf is placed over the fire. But if I understand rightly, in a damp medium like tea fermentation ceases at about 140°F., and as this degree of heat can easily be maintained over a choola, I see no special advantage in the machines in this respect.

HAFA BANANA.

WE recommend a medium amount of fermentation, avoiding on the one hand putting the teas over the fire in too green a state, and as carefully avoiding leaving the rolled leaf till it gets over-dark and highly fermented. To carry out this principle properly, sufficient provision for drying space should be made to admit of every ounce of tea being fired off as soon as the manager considers it has reached the proper state of fermentation.

INDIAN TEA AND ITS MANUFACTURE.

A short time since Messrs. Balmer, Lawrie and Co. issued a small pamphlet containing the opinions of several leading planters on certain special subjects which had been referred to them for consideration. We believe that a very few copies only were printed for private circulation, but hearing of the intended publication of our Cyclopædia, Messrs. Balmer, Lawrie and Co. courteously placed the pamphlet at our disposal, and its contents have therefore been availed of, and arranged in this Work under proper heads.

Fermentation.

Neptune.

To obtain a raw, rasping and pungent flavor I am compelled to underferment, the indication of which is that the colour of infused leaves are of a greenish brown tint. It is the caffeine or theine which produces the bitter taste in tea, the tannic acid its color and astringent properties. The longer the rolled leaves are fermented both compounds alter and enter chemically into other combinations, thus losing their original significations, and the tea assumes a more mellow and palatable flavor after a certain stage, but carried beyond this point, it becomes of a sweetish sour flavor, unfit for consumption, and finally turns putrid. The structure of the cells of the leaf is composed largely of gluten, which is convertible into starch, and this again into sugar, and, as the transformation cannot take place unless under suitable conditions, I must conclude that *over* or a lengthened period of fermentation is the predisposing cause, and therefore this must be guarded against at any cost. *Even* fermentation is necessary to turn out a good flavored tea, and, when hand rolling, I have found this could be secured better by putting about 5 seers of the rolled leaves heaped up in a dallah 18 inches in diameter than keeping them in balls, because with the same quantity, the area of convex surface that is exposed or uncovered is less in the former than in the latter, and besides it offers quicker facilities for turning the mass inside out to ensure all the leaves undergo fermentation, always bearing in mind that *their colour* is no positive proof that they have been subject to the process, as mere exposure to the atmosphere will cause this (in consequence of the tannic acid), whether fermented or not.

The Oldest Planter in India.

I *never* ferment to any regulated time, but always judge by the eye when the bruised leaf has attained a proper stage of coloring. This plan would be risky but for frequent tastings. I do not ball after first roll, but allow the tea to color loose lying about 5 inches thick.

An Authority.

If the balls are opened out for fermentation, the leaf will gradually open out, and lose its close twist, besides fermentation will be equally rapid in balls. The coloring should be finished in two hours at most.

A Cachar Planter.

Insufficiently fired teas go through a second fermentation on the way to the market, which is sure to dull them down, and make the liquor softer than when they left the garden.

A Planter in Assam.

In 1875, Mr. Boyle, of the Brahamapootra Co., started manufacturing pungent teas in a degree similar to the old namuna teas, which ran away with the market in 1864, 65 and 66. On hearing of the prices obtained, all planters tried to find out how Mr. Boyle made his tea. One after the other followed, but, as is well known, only one or two succeeded in reaching a high point, while the others sent in a dirty thin, greenish liquor with neither taste nor flavor—a tea which was as unsuitable for mixing purposes as it was for drinking. Those teas I saw in London, and well understood the cause. My own managers I tried to keep in the old way, but no—all the talk was fermentation, too much fermentation, &c. In 1878, when all you heard of was nothing but tea being put on fires from the machine, I made tea here, and began the season with only 40 mds. charcoal in May. My tea averaged net Re. 1-6; some of this tea was dried even in the wind, and lots fermented unavoid-

ably for twelve and fifteen hours. A small shipment of 6 chests was sold in Calcutta in September of the same year, which was not fired off after rolling for 36 *hours.* The tea seemed sour, so I had it sold in Calcutta. The Pekoe and Broken Pekoe realized As. 14-9, while Brokers in Calcutta were calling out to everyone, they were *over-fermenting,* so I consider the brokers assisted more than the planters to make a lot of rubbish and bring Assam tea into disfavor.

Chittagong Planter.

In ordinary weather and with fairly fresh leaf, about two hours' fermentation is wanted in my cool tea-house to obtain a full liquor, but with over-withered leaf about half that time would seem enough. I have made countless fermentation experiments, and find that the mass made into balls ferments as evenly as in any other way, provided it has received good heavy pressure on the rolling table. Roll opened out and spread thin to color loses its twist, necessitating re-rolling, which injures the outturn and dulls the liquor :—piled up in dallahs to ferment, it retains some of its twist, but acquires a mawkish taste. An undisturbed fermentation in balls seems to be the safest and simplest plan to attain the bright colored outturn which the brokers ask for. I have no doubt other methods of fermentations are best for *fine* leaf: my remarks apply to ordinary leaf, such as is generally plucked in this district. The coarse leaf separated in the rolling process should not be balled I think, as for reasons of which I am not cognizant, it liquors out best, and gives a brighter outturn when fermented loose.

If the tea is not well dried, it is liable to sweat in the baskets during the interval which elapses till it goes into the sorter's hands next morning.

I have noticed that leaf spread out thin on the firing trays as it leaves the roller's hands, and then left to attain the desired color, gives, in nine instances out of ten, as good a liquor as balled or piled-up leaf, which goes towards proving that the result sought to be attained by what we call fermentation is to be acquired by mere oxidation.

Firing.

Neptune.

I dry *slowly* at temperature not exceeding 150° in the choolas, and, as the sun is utilised for the same purpose in conjunction on all occasions, the consumption of charcoal averages only 15 seers per maund throughout the season. I don't think rapid firing turns out such good tea as the former, and provided this system is adhered to, I care not what sort of heat is made use of for the purposes, assuming of course that no foreign matter contained in the medium, as resin, turpentine, oil or smoke, comes in contact with the tea. Those who believe in the efficacy of the antiseptic properties of the fumes of charcoal as beneficial to tea will swallow anything. I never re-fire prior to packing, for the simple reason that there is no necessity for doing so on this estate, as my sorting and packing house is so thoroughly dry and most uncomfortably hot in all weathers, and besides the teas are stored in zinc-lined bins within this building ; no fault has yet been ever found with my teas in consequence of this non-firing.

The Oldest Planter in India.

After once the leaf has attained the proper tint, I fire rapidly what I would style the first "Batty." After this the tea is shifted into long trays 6″ deep, and the drying process finished in these. During the season, while making as much as 700lbs. of tea a day, I haven't used more than 30 choolas. I never let other than aglow charcoal be put under the tea, as, if the heat isn't brisk, coloring goes on to the detriment of the tea.

An Authority.

The roll should be spread less than 1 inch thick on the trays, and half an hour should be taken for firing. The malty quality in tea is imparted by brisk sharp firing. Teas should always have a final firing or hot sunuing before packing.

An Assam Planter

Gives it as his opinion that the absence of the strong malty flavor is due to too rapid firing of the tea and doing away with the panning.

Chittagong Planter.

It is bad economy to try and save charcoal, and I wish I had never experimented to use the smallest quantity possible. Put a tray of leaf ½″ thick over a moderate fire, and another over an all aglow choola, and the difference in briskness and quality in favor of the latter will be very pronounced. The thicker the leaf is spread, the worst will be the liquor, for, however

corect the manipulation may have been prior to the firing process, if the leaf is put over the choolas more than ¾" thick, especially if over dull fires, I find it is sure to go to the bad—it will steam to rags. If it be thinly spread over brisk fires, the tea in half an hour will be 12 annas cooked, and can be spread thick in trays and left to finish four drawers deep, over separate low fires where it cannot get burnt. Five choolas to a maund of tea with double drawers are amply sufficient. The oftener the tea is turned over and shaken the better, and the less chance there will be of over-firing the small stuff.

Another Cachar Planter.

I have tasted teas here (and sent you some samples), and found the outturn right and the liquor strong, and you have reported them dull, soft and bad infusion. The only way I can account for this is, that the teas had not been fired enough or had absorbed some moisture which had caused them to re-ferment. During the last six years there has been no change in tea-making but quicker firing; this gives a pungent liquor, but I am afraid too quickly so. The outer part of the leaf is caked or baked so quickly that the inner part or core of the leaf is left with moisture in it, and which is sure to ferment. Gardens which have gone in for this have suffered the most by the fall in prices of tea; one I know of which fires very quick gets very poor prices when it used to get the highest; when I was at home I heard this mark spoken of in London as under cured.

Sunning.

Neptune.

Provided the air is dry and no rain, I always place the tea after fermentation outside on large dallahs very thinly, whether the sun is obscured or not, and have ever done so for ten years past.

The Oldest Planter in India.

I somehow never dry my teas in the sun. I suppose for two reasons. Not that I have a prejudice against it. First, my tea-house has an east aspect, and I can get no sun to speak of; second, it is generally so windy that half my tea would blow away. I have known concerns sun dry for years in Cachar without the teas being unfavourably reported on.

An Authority.

I am sure it is injurious to put the roll out in the sun as it destroys the malty quality, but sunning teas for packing is not objectionable if spread ¾ inch thick in dallahs, and if the tea can be brought up to a temperature of 120 degrees in about an hour, it should be fit to pack, provided it has been turned over several times during process.

An Assam Planter.

The reason of tea not keeping is too much use of the sun, as for some five years past it has been on the increase, and in 1877, 78, 79, all seemed to sun tea whenever they could manage it, and final fire as well. The difference is, sun will dry leaf and make it into tea, but sun will not cook leaf, while a charcoal fire will do so perfectly as any pan ever did: it is in this you have the real cause of Indian tea losing all flavor and taste ten days after a box has been opened for use in England. I may mention that I never dried tea in the sun in my life until 1878, and then only because I hadno other alternative.

Chittagong Planter.

For some time I sunned my roll, twelve annas or so, because it saved charcoal, and gave a handsome appearance to the tea, making it black and tippy, but I discontinued doing so on finding that it produced a metallic flavor, and dulled the liquor even when the leaf had been spread out quite thin. But sunning before packing, provided the sky is clear and the air hot and dry, seems to bring out a stronger aroma than pucka battying, while there is no danger of burning. Besides the operation is quicker, cleaner and more thorough.

Firing.

Too much care cannot be bestowed on this, the most important part of manipulation. The leaf, after having arrived at the proper state of fermentation, should be quickly fired and well dried, which process ought not to exceed one hour. There is no doubt that quick packing after manufacture tends to keep a rich aroma in the teas, which it very soon loses on exposure even in a good factory. In many concerns it may be difficult to completely fire off the teas on the day of manufacture, but in all such cases they should be so far dried that there will be no danger of their getting so damp and soft as to risk the chance of sourness, which is apt to set in if proper care is not taken.

The day's manufacture should be finished during daylight. With proper arrangements there should be no difficulty in doing this. Manufacture carried on at night is always inferior. Of course there are times when this cannot be avoided, but this should be exceptional.

MEMORANDUM

On the Manufacture, &c., of Tea.

The market for the sale of Indian teas during the past season, up to the present date, has been exceptionally unfavorable, owing to a combination of causes—partly to the prevalence of general commercial depression; partly, it may be, from increasing importation of Indian teas; and partly, no doubt, from these having consisted of an unusually large proportion of low class teas of weak liquor, which, possessing no marked superiority in strength and character over ordinary China growths, naturally sink to the same level of relative value. The first of these causes may be assumed to be temporary; the influence of the second is more likely to increase than to diminish, and can only be met by increasing efforts to attain to a more perfect system of economical working; the last is more immediately within our control, and the best means of combating it merit the most careful attention and vigilance on the part of managers and assistants in charge of estates.

Some of the more important points to be kept steadily in view are:—

1*st.*—*Plucking* the green leaves at an earlier stage of development—allowing at the commencement of the season a free growth of shoots for the formation of young wood. It does not necessarily follow that this would entail any material reduction in the amount of the crop, and any partial loss in *quantity* would be more than compensated for by the higher standard of *quality* and value attained, and by the healthier tone that would be imparted to the London market by the general adoption of this principle. In like manner any partial or occasional reduction in the daily task for leaf gathering, rendered necessary by this system, would be fully covered by the greater money value of the day's work, whilst there would be a substantial relative economy in all the subsequent operations, inasmuch as a maund of green leaf giving tea worth an average of 1*s.* 6*d.* per lb., costs quite as much in charcoal, manipulation, lead, boxes and freight, as one giving tea worth 2*s.* per lb. Taking even the extreme case, then, of a reduction of one-fourth in the bulk of the crop, if accompanied by a corresponding improvement in the quality, there would be a positive saving of 25 per cent. in the items indicated, whilst the market would be less glutted, and the absorption of the inevitable increase of importations incident to extension of cultivation would take place under more regular and natural conditions.

There are no doubt times—such as when a sudden flush of leaf comes out simultaneously all over the gardens—when it would be difficult to carry out this system and at the same time gather all the leaves. If such cases cannot be adequately met by a partial gathering of the suitable leaves over the whole area, then there can be little doubt that, rather than go on gathering coarse large leaf to produce comparatively worthless and unsaleable teas, it would answer better to suffer a portion of the garden to run completely *banjie* for a time, and to turn back and gather the leaf, while in a suitable condition, on the earlier plucked portions. The ease with which a basket may be filled with overgrown leaf no doubt affords a strong inducement to the coolies to persevere in that direction, but this is a minor difficulty which no competent manager would admit himself unable to control. The manager has also to guard against a tendency on his own part to strive after *bulk* in his crop as being the most important consideration, and the test by which he is likely to be judged. The sooner this illusory principle is discarded, and *quantity*, without being lost sight of, made strictly subservient to *quality* and *profit*, the better it will be for all concerned.

2*nd.*—The subsequent treatment of the leaf in the tea-house—the *withering*, *rolling*, *fermentation*, *firing*, *sorting*, and *packing*—all demand careful attention and supervision, if the fruits of all the preceding labour and expenditure—just within our grasp so to speak—are not to be more or less sacrificed and lost. In *withering* it is necessary that there should be ample

space, and in *rolling* that care should be taken to avoid putting too much leaf into the machine at one time, and not to carry the process to excess, thus injuriously affecting the strength of the liquor to obtain, what is of infinitely less value, a well-twisted and good-looking leaf.

Important, however, as these operations are, there is less room for serious error in them than in the following one of *fermentation*, to hit the right degree of which requires more study and discrimination than are generally given to it; and failure at this point is, beyond doubt, one of the most prolific causes of *poor teas of weak liquor*. It is no unusual thing to meet with two samples which, having as nearly as possible the same appearance in the dry state, show such a marked difference in the infusion as to make one worth from 3*d*. to 6*d*. per lb. more than the other—a difference generally traceable to an error in fermentation, though it may also occur in the firing—more frequently from insufficient than from over firing—or from the tea being allowed to lie about and become more or less musty before packing.

While the two extremes of *over* and *under* fermentation have to be avoided, the general tendency is to err on the side of excess. This sometimes occurs from inability to recognise the true indications of sufficient fermentation; sometimes from a want of appreciation of the importance of the point, and allowing it to be treated in a haphazard routine fashion by the tea makers. One cause of over-fermentation may be found in the habit, prevailing in many tea-houses, of allowing the leaf to lie about in heaps too long before firing, waiting for space to be available on the dholes or trays, there being a tendency, more especially in factories where steam is employed for the purpose, to push on the rolling of the leaf without giving any consideration to the adequacy of the accommodation for firing it off while at the right stage of fermentation. Another fertile cause of over-fermentation, producing dull, weak, and sour teas, is want of care in seeing that the fires are kept brisk and bright, and that no more leaf is put on each *chalnee* or tray than can be quickly fired off. When a thick mass of leaf is put over a slow fire, the fermentation of course goes on even more rapidly than before, stimulated by the gentle heat, and a dull, sourish tea is the certain result. Rolled leaf is in a fit state for firing off just as the original green colour is turning to pink. The outturn of the infused leaf should be a *bright salmon brown.*

The first *firing* has thus been incidentally dealt with; the *sorting*, being a mechanical process which may be modified from time to time to meet the requirements of the market, does not call for special remark in this paper, beyond pointing out the great importance of its being done as promptly as possible, to be followed by an equally prompt *final firing*, carried to the point when the tea gives off the well-known malty aroma, and *packing* in a warm state—a most essential condition—so as to preserve the full freshness and aroma of the teas. Delay in this, and allowing the teas to lie about exposed to the atmosphere is next, if next, to error in fermentation,—a most common and potential cause of deterioration, and one which cannot be too watchfully guarded against. Whilst, then, the most strenuous efforts should be made to have all the operations (from the time the leaf is gathered till it is packed as tea) following each other in their due order without needless delay, it may sometimes happen, from pressure of work and an inadequate labour force, that this cannot be accomplished unless at a greater sacrifice than would result from a temporary delay in sorting and packing. To meet such cases, each factory should be provided with a few zinc-lined bins for storing the made teas, or where these do not exist, bins may be easily and cheaply made of ekara and naga mats or machans raised from the floor a sufficient distance to allow of charcoal fires being kept constantly burning below them.

On the subject of *Breaks*, it may be remarked that while it is desirable to have these of a good size, the system of rebulking in London renders it unnecessary that the tea in each break should be of uniform character and quality, so long as it is of the *same class*, and so long as *unsound*, or very inferior teas, are not mixed, or breaked, with *sound* and *decidedly* superior sorts. This admits of packing being carried on uninterruptedly with each day's teas, simply putting the chests containing each class by themselves till they are numerous enough to form a break which should not, if possible, consist of fewer than fifteen chests.

As a final, and very important suggestion, it should be a rule with every manager or assistant in charge of a tea-house, to practise frequent, if not daily, tasting in the cup, carefully comparing the liquor and infused leaves with those of samples known to be good.

This being the test by which brokers and buyers in England are guided in the

sale and purchase of teas, it is certainly no less essential that it should be systematically and carefully applied by the producers in India, in order to obtain an approach to certainty, or anything beyond empirical, haphazard results, in the standard of quality.

To many experienced careful managers, these suggestions may read as so many truisms, with which they are already thoroughly familiar; and we are happy to be able to point to several by whom they are duly appreciated and acted on. On the other hand, there are numerous instances where there has been such manifest failure in one or more of the above primary conditions of success, with corresponding loss to the owners of tea property, that we deem it our duty, in the present rather critical position of the Indian tea interest, to draw attention to them in as prominent a manner as possible.

GEO. WILLIAMSON & Co.

IS CHARCOAL MANUFACTURE ESSENTIAL TO THE FLAVOUR OF TEA?

IN dealing with the probable revolution which may be effected in tea manufacture, and the greatly increased area of cultivation which may take place, should tea-drying by machinery be really found practicable, there is, it will be seen, an important factor to be considered: the effect of charcoal fumes on flavour.

It is generally believed, and we think with chemical proof for the reasoning, that a great deal of the flavor of tea is developed by the products of charcoal combustion. It is within the range of possibility that some means may be discovered of meeting this necessity, even with the use of a tea-drying machine; but that mere heat will supply that which at present charcoal undoubtedly does, we do not believe. Colonel Money, speaking on this subject, says, that in his opinion the fumes of charcoal are *not* necessary to make tea; but he adds, "I have never made tea with any other agent than charcoal, and I have never met with more than one planter who had. He said that tea was not good." Colonel Money continues:—"The only effect of charcoal, theoretically speaking, is to drive all the moisture out of the roll, and thus make it tea." That is to say that, assuming charcoal simply to represent heat, any other heat would equally answer. But Colonel Money's reasoning amounts to a simple "belief," without proof or experiment, that heat alone *is* required—a fact very far from proved. Mr. Cottam, writing on the subject, refers to the fact that the leaf in the process of firing has been known to imbibe a tarry flavour, from the charcoal used having been manufactured from an improper description of wood. Does he assume, therefore, that it is better to keep all gases from the leaf, and trust to the agency only of simple heat? The instances in which an impure flavour is conveyed by charcoal must be rare indeed; and that the pure flavour of tea is developed by the use of charcoal, has hitherto been generally accepted. The question seems to be, not so much a denial of this, but whether it is possible by any other means to supply the gases and chemical action which charcoal develops. It is somewhat surprising that, in a matter of so much importance, no more certain conclusions have been arrived at. The question is surely capable of practical solution. It may be that heretofore, in the absence of any other suggested means for drying tea, the matter has slumbered; but it becomes necessary now to

decide the point; for upon the decision rests the feasibility or otherwise of any change in the present method of tea-drying.

WITH reference to the preservative effects of the use of charcoal in tea manufacture, my idea is that it is not to the charcoal we have to look for chemical properties, but to the leaf which is being dried. Charcoal fumes are a well-known disinfectant and deodorizer, and this is effected by the absorption or neutralization of objectionable matter. Why may not the same be the use as to tea?

If the fumes of charcoal immediately after passing through the tea were collected in a closed chamber, some trace of additional matter would, I think, be found on testing. May not the whole thing lie in a nut-shell?

"IF tea cannot be made without charcoal without losing some of its good qualities, how is it that much tea is "fired" on zinc sheets in the sun, and never any complaints made about it (that I have heard of)? I think there is a very general belief that tea so made is better than charcoal "fired" tea.

REPORTS ON TEA SAMPLES MANUFACTURED BY TEA-DRYING MACHINERY.

WE have had samples of tea manufactured by steam-drying machinery fully tasted. The result is highly satisfactory, and seems almost to dispose of the vexed question of *Charcoal drying*, as well as to initiate a much-needed economy of manufacture.

Reports on Tea Samples. manufactured by Steam-drying Machinery.

Sort.	W. C. Hulbert & Co.'s Report.	Valuation.* London.	Valuation.* Calcutta.	Cresswell & Co.'s Report.	Valuation.* London.	Valuation.* Calcutta.
		£ s. d.	Rs. As. P.		£ s. d.	Rs. As. P.
1. Pekoe ...	1. Grey black, even wiry leaf ends, brisk pungent fine, rather wanting in strength ...	0 2 7	1 3 0	1. Black grey slightly brown mixed even wiry twisted leaf, good tips; not strong malty flavoury liquor ...	0 2 6	1 2 6
2. Broken Pekoe	2. Black, even tippy leafy broken, many ends, strong pungent liquor ...	0 2 10	1 5 0	2. Blackish little mixed, little irregular, leafy sort, good tips, well tipped, strong and pungent ...	0 2 8	1 4 0
3. Pekoe Souchong ...	3. Blackish bold little twisted leaf, thin little brisk liquor. Uncertain.	0 1 7 to 0 1 8	0 11 3 to 0 11 9	3. Black and brown mixed bold, very long irregular leaf, wanting in style and make Not strong, pungent and flavoury liquor	0 1 6 to 0 1 7	0 11 0
4. Souchong ...	4. Grey bold irregular open ~~twisted~~ leaf, thin poor liquor.	0 1 5 to 0 1 6	0 9 9 to 0 10 6	4. Much as before, little more irregular, but similar in water ...	0 1 6	0 10 9
REMARKS ...	*The infusions of the above teas are rather dull.*			If anything worth more than valuation.		

• Exchange, 1s. 9½d. Freight, £3. Full Commission.

I should like to know whether a sample of tea entirely dried by a tea-drying machine with wood or any other fuel has been tested by analysis with another dried by charcoal, both samples having been manipulated of leaf plucked from tea bushes close together, and in the same manner manufactured, except the drying. If so tested, what was the difference?

There is yet another test. Let a charcoal-prepared sample, and a non-charcoal prepared sample, be laid aside for 18 months, and let it be known which stands keeping best. This seems to me the most valuable test.

The old question—is charcoal necessary—is still to the fore, and demands solution.

Like many other questions relating to tea, it is so surrounded by old prejudices and recent variations in practice, that the end in view is somewhat hidden; all we need is simply to dry or dessicate the leaf, after rolling, so as to prevent *over*-fermentation.

As a rule, the more we learn of tea manufacture the simpler it becomes. Forty years ago the fumes of charcoal were considered essential to the proper "curing" of the leaf. Later on, teas dried by heat radiated from iron flues were well reported upon, and recent patents have been taken for this method. It is now found that teas dried wholly in the sun, and even packed in the sun, are at *least* as good as the best teas made in any other way.

I know a garden that manufactured over 500 maunds last year, and with an average "all round" of over Re. 1, yet the greater part of the crop was dried and packed by the sun's heat alone, and a fire was not lit once for three weeks during the height of manufacture.

When questions of "timber for charcoal" and "drying machinery" are becoming urgent, this is well worth knowing.

The day will soon come when the sun's heat will be far more systematically utilised, say by a wide southern verandah, roofed with "slag" glass and in which drying will at all times go on, if the sun is out, by the sun's heat, and if cloudy, then by artificial heat.

Tea can be dessicated by—

1st.—Heat from charcoal fires—radiated.

2nd.—Heat radiated from flues or pipes.

3rd—Dry air, hot or cold, passed through the tea.

4th.—By the sun's heat direct.

Of these the most used hitherto has been No. 1, *i.e.*, heat mainly *radiated* from charcoal fires. No. 2 is the subject of patents and partly in use. But No. 3 will be the method —no doubt generally—of the future. No. 4 being applicable at once, and also available in the future in conjunction with No. 3. Sun's heat is 150° to 160° and over. I may mention that there is some difference between air heated by flues, and air heated by passing direct through live charcoal. In the former the air passes on intact, and simply is plus so much heat. In the latter case it is also *minus* so much *oxygen*.

Fermentation means "oxidation;" and hence the air, heated by passing through lighted charcoal, tends to arrest fermentation more rapidly than it would if only heated in flues.

The "fumes of charcoal" are no more a *necessity* than "panning." It also at one time was considered quite indispensable—and has gone out of vogue with no loss. The "fumes of charcoal" will soon follow it; and, relieving us to that amount, enable us, so to speak, to breathe freely.

S. E. Peal.

From what has appeared in the *Indian Tea Gazette*, the process of drying leaf in Assam is confined to the use of charcoal; and the question has arisen, whether the pure flavor of the tea can be developed by any other means than by the chemical action of charcoal gases?

The use of charcoal has been abandoned on the best-managed tea estates on the Neilgherry Hills, as being both expensive and laborious; besides, the pure flavour of the tea must remain in its integrity free from deterioration when kept from the direct fumes of the charcoal, which too frequently is not sufficiently charred or converted into charcoal; and thus the flavor of the resinous substances, contained in the cellular tissue of the different woods, is prevented from being imparted to the tea during firing; moreover, the heat can be better regulated by this system than that of the rude charcoal fires, so that the tea is not so liable to be burnt or smoked during the process of drying.

When the leaf has been sufficiently fermented, it is placed in a series of drawers—the lowest drawer being about two feet from the iron plate, which is again two feet from the furnace outside the tea-house from which it receives its heat. By this means the tea is cut off from direct contact with the fumes of the charcoal or wood.

This method, although still imperfect, must necessarily be cleaner than the charcoal system, as the ash or dust arising from the charcoal cannot, in any way, reach the tea whilst firing.

The writer of this has tried both systems, and since he has introduced the furnace plan into his garden he has heard no complaints against the quality of his tea; and he believes the brokers and others in London or elsewhere are not able to detect the difference, and he has twice sent tea to Calcutta for valuation, and the last batch made by the new system was priced 4*d.* per pound over the former—both being Pekoe.

There are doubtless many imperfections in this Neilgherry method susceptible of improvement; for instance the iron plates, from con-

stant expansion and contraction, are liable to crack, and also to injure the chunam in which they are set. This, however, the writer thinks, can be remedied in a great measure by the introduction of other material less liable to the influence of heat. Should any further particulars be required, the writer will be glad to give the same.

Coonoor. NEILGHERRY PLANTER.

SEVERAL letters have appeared in the *Englishman* respecting the proper method of drying tea—Dry hot Air *vs.* Charcoal—and attributing the non-keeping qualities of tea to the fact that it had not been dried by charcoal. Many will recollect that in the infancy of tea some planters, although panning and using *charcoal*, did not dry their teas sufficiently, so that it arrived in England out of condition,—some of it even sour; but now it appears (*Query*—is it so?) that the teas deteriorate sometimes after they arrive in England. Is this merely a cry trick of the trade to lower the value of tea, or is it a real fact? There is no mistake that the hot air from charcoal fire is a very pure air, and no one would wish to set it aside if it could in future times be relied on,—a constant unfailing supply; but we cannot shut our eyes to the fact that the forests are fast falling under the axe, not only for charcoal but for boxes, and all kinds of timber required for factories and firewood for the coolies, so that all provident planters will look ahead, and search for some other means for drying tea either by steam and a very little charcoal, or by the numerous inventions for the drying of tea by hot air. Of course, as suggested by Mr. Schrottky, it would be advisable to make experiments by competent planters, and the samples should be sent home and tested by faithful men in the trade, and also by scientific men. In my opinion if tea is *properly* fermented, and at *the right time*, dry hot air will preserve it as well as charcoal; but if there is any putridity by improper fermenting or at *the wrong time*, then the best means of drying and preserving it is undoubtedly charcoal. When once putrid fermentation has set in, then there is no knowing where it will stop. All the Bankers and Agents for gardens are reducing the expenditure to the lowest minimum point irrespective of good manufacture, and they ask for quality, and do not know how it is to be obtained. Orders are sent up from Calcutta that the teas are not to cost more than a certain number of annas per lb.; and the only matter that the planter can possibly reduce is the number of his coolies: and he tries to work the oracle merely to save the pay of extra coolies: the leaf is only brought in once a day instead of twice in cool localities, and three to four times in warm localities. The leaf is in fact fermented in the basket, and no other care can bring it round. Again, when the leaf is brought in on account of too few coolies, as much leaf as possible is carried into the withering loft, and there it is left to over-wither or rot, so as to avoid the expense of carrying from the leaf shed. Others go in for natural withering, and let it remain to be withered by itself, and never carry it to the withering loft: here more than ever is the chance of putridity ensuing. The old rule of withering in the sun is quite given over. In former times withering in the sun was always attempted, and usually took only a couple of hours; the temperature of the sun varies from 90° to 120°. The action of the sun is purifying; but we cannot always get the sun, so we are forced to make withering lofts and so attempt to attain the action of the sun, and take 10 to 24 hours to wither the leaf: is this right? After the tea is rolled is the proper time to ferment,—not before; and this must be studied so as to obtain a sweet fermentation. Let these matters be studied, and then make experiments with charcoal and other hot air, and the question will be set at rest.

But although this cry has come from England, yet it is very vague. To solve the question properly we should know under what condition did the tea deteriorate. Was it because it was bulked and then sent away in open *chests*, and so kept for a twelve month? Why, even the Chinese do not do this. Or is it found to deteriorate after it is mixed with the dirty-faced China teas? These are important questions that should be answered by people who make the complaint. That the question should be set at rest, I quite agree with Mr. Schrottky; but Mr. Schrottky from not (perhaps I may be incorrect) having been on a tea plantation, is not aware that most of the Indian tea made for mixing is not fermented,—only coloured and placed over the drying fires almost immediately it is rolled; in fact it is half green, or analogous to green tea or to the China Oolong tea; whereas China tea is fully fermented to the border of putridity (and therefore requires charcoal): in fact much of it is putrid, for both green and black tea of China make, after infusion, by

mere pressure of the finger and thumb become pulp, and all the dirty facing exudes on to the fingers; it is this dirty facing (lamp black, &c.) that soils Indian tea when mixed with it. Get the Chinese to supply pure tea, and all these objections to Indian tea will soon pass away. The new fashion of quick drying by hot air may have something to do with the question, for if dried too quickly the leaf is only skinned over, while the interior is moist; therefore the pucca-battying advocated by "Newotha Bill" should be thoroughly carried out. Sourness precedes putridity, but there is a stage before sourness which I call the alcoholic stage, and it is a stage of no flavour, for vinegar only comes from alcohol. Most likely the tea is in this stage of which complaints are made, and we require scientific men to tell us in what stage it really is.

The number of minutes proper for the requisite drying of tea is very important; all the experiments that I have made have made me averse to too quick as well as to slow drying: and this must be studied by the planter. Also the number of minutes after the leaf has left the rolling machine and putting it on the fires, so as to ensure the proper sweet fermentation if tea for drinking without mixing is required; fine leaf less time, coarse longer time. If Mr. Schrottky can prove to us that, by chemistry, he can give to hot dry air the preserving properties of the hot air from charcoal fires, it is a great thing, and if necessary we ought to avail ourselves of this knowledge.

Years ago when I first mooted the idea that tea could be fired without charcoal it was scouted. It was said: "The fumes of charcoal had some chemical and necessary effect." The Chinese would not have used it from time immemorial had a substitute, and a cheaper one, been practicable. Such were the objections. It is now no longer a question. A great part, perhaps the greater part, of the Indian produce is to-day worked with other fuel, and it is only a question of time when *all* of it will be. It is generally admitted that tea prepared in dryers is more valuable than that fired over charcoal, and begging the question that the fumes of charcoal are *not* necessary (the old idea is very nearly exploded), it is reasonable that it should be so; for, if there is one thing certain in tea manufacture, it is that speed is necessary. Charcoal drying took on an average 45 minutes. Tea is fired in the best dryers in 8 minutes. The following are the results of a long series of experiments. The valuations were made by more than one Calcutta broker:—

Class.	Charcoal Dried. Indian value. Rs. A. P.	Charcoal Dried. English equivalent. £ s. d.	Machine Dried. Indian value. Rs. A. P.	Machine Dried. English equivalent. £ s. d.
Pekoe ...	0 11 0	0 1 6	0 14 0	0 1 10
Broken Pekoe ...	0 10 0	0 1 5	1 1 6	0 2 7

These were made from the same leaf at the same time, with every care.

E. Money.

General Notes on Tea and Tea Manufacture.

Jungle.

Jungle is very much abused, but it has its uses in keeping the soil from being washed away while it is growing, and when turned topsy-turvy it still does the same thing. Grass, at the edge of terraces, is

very useful. It should not be allowed to grow too large or too high, but should be kept down with the knife or sickle. One of its greatest uses is in the cold weather,—keeping the ground damp, and protecting the exposed side of the terrace from the drying effects of the westerly winds. Two small gardens, in which this year the grass was left on the edge of the terrace, and not deteriorated by any use of the knife, flushed earlier than any well-cultivated, well-pruned garden in the hills; so that, in my belief, grass at the edge of a terrace is useful; but it should not be allowed to get the mastery. If it is left for a whole season without trimming and reducing, no wonder it is a nuisance; but as the gardens ought to be hoed six times in the year, so each time the edge of the terrace ought to be trimmed, and the grass cut down to within an inch of the ground as part of the labour.

Weekly or Bi-Monthly Plucking for Tea.

I have seen two letters touching upon the advisability of fine or coarse plucking in the case of the tea plant, or, in other words, of plucking at shorter or longer intervals.

The manner in which the plucking is conducted must affect the entire economy of the plant; upon the system adopted must depend the very health and existence of the bush. I am sorry therefore that the experienced writers of the letters above alluded to did not analyse and explain for the benefit of their readers any system of plucking indicated or advised.

It is not easy to see why it should matter much whether the leaf be taken a little finer or coarser, or at few days interval more or less, provided the system adopted be calculated to thoroughly tap the plant, allowing and promoting at the same time the best available growth; so far as quantity is concerned such should be about the same. Extremes of plucking have been advocated at from intervals of five days to one month. What we, therefore, want to ascertain is that golden medium when we shall obtain the largest crop of the most marketable leaf, and at the same time do full justice to the plant.

In taking any crop, whether such be leaf, fruit, or a direct supply of the "return sap," as in the case of the rubber and toddy trees, the most we can look for without dealing injury is always the same, *viz.*, a crop taken from the greatest supply of surplus sap the plant is capable of producing, while at the same time itself retaining sufficient for its necessary development.

In plucking finer leaf, the flushes must be taken in quicker succession than in plucking coarser, or the plants would run out without ever being duly tapped; but it need not follow from this that one system of plucking more rapid than the other need on this account give a diminished yield or less good development in the case of the plant.

If the flushes be so broken down by coarse plucking as to be injured and checked in their growth, then a generally undeveloped state and hard tendency must ensue. For a time after the injury is done, the plant only sticks and hardens, thus losing time when it should be going on. On the other hand, if plucking be so extremely fine that to get a crop the flushes must be taken in such rapid succession and at so young a stage that it is not possible to establish normal growth, then of a necessity the bush must be driven into countless spray, which must quickly shut up and leave the plant cramped and powerless without having yielded a legitimate crop; in either of the above cases the prospects for the ensuing season can be but poor.

Upon the more developed leaves the trees chiefly depend for their vital action; the very young leaf, while in a state of rapid development, is rather feeding upon the parent, than itself acting as a vital organ. If a plant, or any part of a plant, is running itself unduly out, if the young growth is in fact acting like a "thief in the candle," then, by pinching off the tops, the evil is arrested, and stronger development is obtained; but if, in the case especially of a delicate plant, this pinching is too heavily done, weakness instead of strength will follow, and it had better have been left alone. Beyond doubt, breaking down too deeply into a shoot causes an injury, while light pinching does no harm so long as an immediate supply of new leaf is not required. This would, I think, indicate that the younger the leaf the tea crop can practically be composed of, the better, both for quantity and quality, due regard being always had as to thoroughly tapping the plants, while at the same time jealously watching that they are allowed their due growth.—*Englishman.*

Charcoal and other Withering.

Withering.—Too long withering by charcoal is bad, as it makes red leaf, particularly if there is a draught in the room; but in Darjeeling we have so much rain that we could not wither 5 per cent. in the sun. Withering in the sun, on galvanised corrugated iron, is, I believe, the best, but not in a strong wind. Wind or draught in the withering-room dries the leaf too much, makes it leathery,—hence red leaf: still air is required. Withering on corrugated galvanised iron makes the darkest liquor. The temperature ought to be studied. The right heat for withering is about 100 degrees; but in a room covered with corrugated iron, on a wet day, the drying room should be 120 degrees, so as to maintain in the upper withering loft 105 degrees. Charcoal fumes are not good for withering; but in the present arrange-

ment of the tea houses in Darjeeling it cannot be helped. Keeping the leaf in a moderately cool room for two days, thinly spread out, the leaf will wither by itself. The shorter time the withering, the stronger the tea. In this month, when the leaf is thinner than in the earlier part of the year, and the garden is cultivated so that there is some sap in the leaf, two hours is quite enough for fresh leaf, and one hour for stale leaf; but although you may wither properly, all the pungency may be lost if you have too strong fires. If you are too long drying, the colour of the leaf is dark, and the liquor dull.

On Fermentation.

Fermentation can be carried to putridity. I do not like the expression; for to many it gives a wrong idea. The colouring, (in other words oxidation), of the leaf is simply made, firstly, by bruising, in the act of rolling—not *crushing;* secondly, the colour is brought on quickly by exposure to the atmosphere, thinly spreading out 1lb. to 1½ feet square. In 30 minutes, in a temperature of 100° F., it will colour rapidly: throw it in fires about 1lb. to the square foot; dry in 1¼ hours. To do this you must take care that there is neither too much nor too little charcoal. All must be done by extreme method. If we take all the care possible, rarely two feeds of the machine have the exact same flavour, owing to some trifling cause: the fires may not be quite the same heat—the *choola* cooling by the time of the bud firing; withering-loft getting a trifle too hot, in spite of opening the windows; the temperature of the air rising or falling; the leaf being not in the same condition for plucking—perhaps a day too old or a day too young. In some days the leaf will heat in the machine; in other times it comes from it perfectly cold. In some factories, at low elevations, to make pungent tea it is necessary to throw the leaf on the fires directly it leaves the machine.

If we could dry by cold air, there is no doubt that we would make very pungent teas; but they may not be pleasant drinking tea. The heat from the sun; air passing through pipes heated by steam; pipes heated by fire—all have different qualities and give different qualities to the heat. I prefer air passing through pipes made red hot by fire, as the air is more oxidised, and more approaches the hot air from the charcoal. (*See* Mr. Dickinson's Patent.) In drying by charcoal we have one great difficulty: that is, keeping the drying house clean. From using the ashes to cover the live charcoal, the ashes are burnt over and over again, and become so fine that it is impossible to sweep them up. It is absolutely necessary to sweep the drying-room at least once a week—sometimes oftener, and therefore any system which tends to cleanliness especially, and the possibility of maintaining an even temperature, is sure to succeed. Where steam is used, I believe it should be dry superheated steam.

We require the chemist as well as the entomologist. Let us analyse the different stages of teas; let us work backwards. Tea will become putrid. Before this stage comes the vinegar or sour stage; vinegar comes from alcohol; alcohol from grape sugar; grape sugar from gum or starch. Chinamen like the tea in the saccharine stage, as they drink it without sugar or milk. We prefer it in the gum or starch stage, which we make pleasant with milk and sugar. Alcohol is the stage of no flavour. The vinegar stage all well understand; but on account of different qualities in the air-heat, (damp heat or dry heat) all these stages are lengthened or accelerated; and it requires incessant care on the part of the manager to hit the right method for each day.

The fumes of charcoal put a very pleasant grey (to look at) plum-bloom on the tea leaves. This is all taken out in sieving. We want a process to sieve the leaf after it is rolled, and before it is put on the fires, so as not to sieve afterwards, or to pluck the leaves separate, or to sieve it before going into the rolling machine. Our teas would then look twice as well.

I have the pleasure of forwarding two extracts from S. Ball's book called *Tea in China.* What was true then, appears equally true now, and worthy of attention:—

"Unless attention and skill be exercised in every part of the cultivation and manipulation, the teas will be found different in weight and inferior in quality. Thus, a plantation ill pruned, which would otherwise yield 100,000lbs. of tea, reckoning 1lb to ten bushes, would produce only 85,000lbs, and if badly manipulated, only 70,000lbs., and this quantity would also be reduced in value 20 per cent. together making a loss of 4*d.* the lb. In fact, the plantation would not pay. The planter might ascribe the failure to many chimerical fancies, but in truth it could only be attributed to unskilfulness and indolence."

(Page 87) "After the first year the plants are topped, hoed and manured. The manure is used both in a liquid and dry state. It consists of a mixture of mustard seed and dried Sardines (a kind of herring) oil-cakes of the *Brassica orientalis*, and other coleworts, together with human dung and urine. These manures are found by experience to be suitable to the heavy soils congenial to the tea plants, and to exercise a decided influence in the improvement of the shrub."—(*Nippon*, Part 6.)

DETERIORATION OF TEA.

NEPTUNE.

I WOULD prefer making the drinking teas of past times, but as brokers call for strong cabbage water for mixing purposes, I am obliged to make a raw unfermented article.

THE OLDEST PLANTER IN INDIA.

MY belief is that tea has reached that stage with regard to its market, that those that won't conform to the requirements of the dealer in the matter of bulking and packing in even tares will go to the wall, in so far that they will fall into the hands of middle men who will buy up small breaks and bulk with all the producer's profit going to them for their pains.

A KUMAON PLANTER.

THE soil, I believe, from the constant cropping it has been subjected to without adequately returning to it the constituent parts abstracted, has become so impoverished that it cannot now as a general rule produce vigorous healthy leaf without which good tea cannot be manufactured. The various blights with which the tea bushes are chronically affected now seem to me to point unmistakably to a deteriorated soil in which the tea bushes grow, and, unless prompt and stringent measures are taken to improve the soil by manure and good and adequate cultivation, the Indian tea bush will become a permanently diseased product of nature. It seems to me that if every tea estate in Bengal would allow the fields where the tea bushes are afflicted with Red-Spider, Mosquito and other blights to lie fallow for several years, the recuperative forces of nature by which the soil attracts from the atmosphere, ammonia, carbonic and nitric acid, would remedy what has been brought about by means of neglect and eager hastening to be rich at the expense of the unfortunate tea bush.

I believe that almost the universal neglect of panning the tea, and the use of charcoal in the first and final drying, have deteriorated still more the tea made from deteriorated leaf, and rendered it liable to go bad if kept any length of time. It seems to me, and has seemed so all along, that the precepts and practice of the Chinese have been too lightly valued by the British tea planter as a rule.

CHITTAGONG PLANTER.

I CANNOT agree with you in attributing the fault to the short time now allowed for pucka battying, because teas made in this district, and which have never been so treated, fetched high prices and pleased the brokers in past years, while those who have adopted pucka battying recently, with the hope of improving their teas, have not obtained better valuations. Naturally however teas must be better for being dessicated more than once, especially before packing. Wherever the fault originates, it developes itself pretty freely during the time the tea is in bins *preparatory* to packing, and it is found advantageous to pack the day succeeding manufacture.

A DARJEELING PLANTER.

I AM not aware that there really is any deterioration in the quality of Indian teas, at least as far as Darjeeling is concerned. For the last five seasons (including this), I am certain that Darjeeling district taken all round has turned out a finer quality than it did during the five previous seasons—1871 to 1875. Prior to 1871, I believe the flavor of Darjeeling tea was fine, owing to the gardens being young, very small outturn per acre being the rule, and pungency not being required by the brokers, &c. This demand for pungency has been against the quality of Darjeeling teas in my opinion, as they ought to rely on flavor. As regards the keeping quality of teas as well as flavor, I consider this has been injuriously affected by the giving up of "panning," but this only amounts to an opinion of course, and must be taken for what it is worth.

A CACHAR PLANTER.

I SHOULD be inclined to attribute the cause of the falling-off in consumption to the British public, owing to depressed times, demanding a lower priced tea than formerly

rather than to "non-keeping" properties said to have been discovered in Indian teas, for this serious fault must surely be confined to the tea of a few gardens only, whose mark would soon be avoided. In what respect is Indian tea said not to keep? Does it become soft and mildewy? Because this might be due partly to the very thin lead that is now used compared with old times, though I am inclined to agree with you as to the cause of "non-keeping" of Indian teas, and I certainly do not think it is a fault that can be found with my teas, for they are always "pucka-battyed" over slow fires for at least 12 hours before being packed, and this is I think the only custom of the old days that is retained in my tea-house, but one that I always approved of and therefore never changed.

Another Assam Planter.

The deterioration of Indian teas is a subject that I have taken great interest in since I was at home in 1877. In those days the evil was confined to one or two marks, and the cause was supposed to be from something peculiar in the style of manufacture of those marks, and not as has been discovered, from those marks having been brought more prominently before the leading merchants, or from so few teas then being kept back for sale.

My own impression at the time was that our teas "went off" from not panning, and I had a steam heated pan made similar to those used by "Sugar Boilers," to take the place of the old fashioned ones. We gave up panning teas in 1871, because it was stated "unpanned" teas were just as strong, and there was no chance of burning them: the supply wasn't equal to the demand, and our teas went into immediate consumption; they were not wanted to keep, they were only used for mixing, and the mellow flavor produced by panning was not required. An old China tea-maker told me, if you are going a week's journey pan lightly; if a year, pan as hot as you can; of course there is panning and panning; if you pan with a great heat you have to be very smart or you burn your tea, while if you use a cold pan, your tea would want briskness. I am not prepared to say a steam-heated pan is an entire success, but the great advantage is you can't burn your tea, and you can keep up an even heat. I have never discovered on what authority "panned" teas were discarded. The leading people at home never had the matter properly placed before them. A shipment of unpanned tea was sent home and approved, but no investigations were made to guarantee such a radical change. Planters were only too glad to get rid of a tedious and risky process; and with that took to "pucca battying" their teas a quarter of the time they formerly did. I remember when teas were "pucka battyed" for 20 hours, now 4 hours is often sufficient, and in some gardens the teas are simply warmed and packed. These two things, non-panning and light battying, were brought in force about 1871 I think. Still planters used to pan if they found their packing getting in arrears, and you generally find old planters pan their own drinking teas, because it makes better drinking tea and keeps longer. These two points are well worth enquiring into, and after that you may travel home and see how our teas are treated compared with China. When tea arrives at home, I believe it is placed in bond, sampled and weighed; with Indian teas sampling and weighing means "bulking." I speak advisedly, and am open to correction. China teas are bulked in China, and do not stand the same test as Indian teas do. If our teas are bulked in a London winter fog, and then packed cold, and kept some months for sale, it's no wonder that they deteriorate in quality.

Another Planter in Assam.

My belief is the same as that of the writer of the letter in the "Englishman" that teas are not sufficiently dried now. When I was in Cachar, final firing occupied from 8 to 10 or 12 hours; of course the teas were kept all this time over slow fires, and were thus thoroughly dried before being packed; now scarcely a third of the time is taken up in the final firing. I do not think with Mr. Schrottky that drying by machinery has caused this deterioration in the keeping properties of Indian teas. A very small portion of Indian teas are so dried. Those that are thus dried, if dried rapidly, might have the effect of drying the tea externally only, leaving some moisture in it inside. Nor do I concur with a later correspondent of the "Englishman" who scouts the idea of Indian teas not being sufficiently dried now, but attributes the non-keeping quality to teas not being panned now as formerly. I believe rolling machines have a good deal to answer for in making bad tea and low prices. I know it quite bewildered me. There was no use trying to get the leaf to put on a good color. Do what you may the result was the same. Roll much or little,

ferment little or long, it made no difference. Now I think you will find my teas very superior to any sent from here during the past three years.

Another Assam Planter.

A deal has been said about the old use of the pan. I worked with a pan for some six years in Assam tea, averaging from 2*s.* to 2*s.* 3*d.* gross. I stopped the pan, and my teas for some eight or nine years went on bringing the same prices. No difference was ever noticed either in reports or prices after leaving off the pan.

Messrs. Balmer, Lawrie & Co.

Complaints of the injurious effects of the iron are not new, for several planters have drawn our attention to it, but we have not had the opportunity of observing so marked a difference in the quality of tea made under the two different conditions.

We are inclined to think our Kumaon correspondent lays too much stress on the effect of the want of manure in causing a deterioration in the tea bush; doubtless on old gardens this may safely be assigned as the cause to a certain extent of inferior tea being made, but the same will scarcely apply to young gardens, and especially where the soil is so rich as in Assam. That manure increases the yield enormously there is no doubt; from carefully watched experiments with a patent manure the increase was found to be 4½ maunds per acre over the unmanured portion; the question however remained, would it pay? This we somewhat doubt, such manures being very expensive, but are not at present in a position to say. That the want of manure may have something to do with the prevalence of the different kinds of blight is possible, for though as a rule now that blight has got a footing it is found to attack manured and unmanured portions alike, we believe the manured is generally found to throw it off soonest.

Having had pretty convincing proof of the improvement effected by wood-lined rolling boxes, we should most strongly recommend our friends to either cover their rolling tables or rings with wood, or to order new ones; we are quite certain that a great improvement will be found; new rolling boxes and tables lined with wood for Jackson's machines only cost about £30, and we presume Kinmond's would be about the same. There should be little difficulty in making them on the garden; the remedy is a simple one and well worth trying. We are glad to say that Jackson's new rotary machine, which is lined with teak, gives a beautifully light fermentation. We notice that the complaints of the effect produced by the iron in the Rolling Machine are more numerous in bad weather.

Regarding the firing of the tea, most of our correspondents agree with the view put forward that the "non-keeping" of Indian tea lies in a great measure in the fact that too short a time is given to "pucka-battying;" according to one as much as 20 hours were given to this process in former years, while 12 hours seem to have been the usual time; now-a-days it is often done in 2½ to 3 hours, and in one of our gardens we learn that last year 1 hour was all that was allowed, while in Chittagong apparently there is no "pucka-battying" at some gardens. It does not require much argument to show that this difference must have produced a change for the worse in the quality of tea, and we recommend therefore that not less than 10 to 12 hours be given to "pucka-battying" over slow fires.

There are many other points of course that it would be well to study carefully; so delicate is the manufacture of tea that where a system or certain "dodge" is found successful on one garden, it is a complete failure on another, so that it is impossible to dogmatize on any one system.

The opinions as to value of "panning" are rather contradictory, and we are scarcely at present prepared to advocate it, but should be glad to have more opinions.—*Indian Tea and its Manufacture.*

Deterioration of Indian Tea.

At the annual meetings of Indian tea companies, as well as in the brokers' overland prices current, constant laments have been made that the producers of Indian tea—those in care of the plantations—have continuously sacrificed quality to quantity; the deterioration, in point of fact, has been of a most marked and serious character. Take a quotation from one of the most unquestionable authorities on Indian tea, Messrs Lloyd and Cheshire, who said, in their "Indian Tea Market Review" for the year 1877:—"It is a notorious fact that the proportion of good and useful tea is much less than formerly."

The same authorities (under date January, 1881) say in their "Indian Tea Market Review for 1880":—"Assam growths, with the exception of a few early in the season, have shown great falling-off in quality, and are *decidedly below the average.*"—*The Grocer.*

PART IV.—TEA IN INDIA.

TEA CULTIVATION &c., IN ASSAM AND CACHAR.

After several years in Assam, the fates changed my quarters to Cachar.

Owing to interrupted communication in the railway steamers plying between Goalundo and Naraingunj, I was obliged to go by one of the I. G. S. N. Co.'s steamers from Calcutta to Silchar. We had a very fair passage —thirteen days—and I must say that the trip is far preferable to the Assam one from Goalundo. On the latter, everlasting sand-banks and grass-jungle meet the eye—a description of scenery certainly oriental in a way; whilst on this trip the sight is pleased with more variety, and the loneliness is lessened considerably, as compared with the passage to Assam, by the river stations generally being much larger, and bearing less similarity to "Eden" in "Martin Chuzzlewit." One advantage of living in Cachar appears to me to be the possibility of reaching Calcutta sooner than from the upper stations in Assam. Either by steamer or country boat, in a few days one can reach Naraingunj, and by taking the railway steamer to Goalundo, fetch Calcutta ere many days have passed. The feeling of being nearly out of the world is not so great when we know that civilization can soon be reached.

I was most struck on arriving here, and in going about, to notice the number of married people. I suppose a community of married men is very similar to a sheepfold; if one inhabitant gets out and strays away from the usual quarters, others are certain to follow. Married folks in Assam are like ice-machines in planters' bungalows, "few and far between." The next thing which attracted my attention was the roads. Upon the whole, what I have seen thus far of Cachar, causes me to prefer it to Assam; therefore, it must not be thought that I wish to run down the district of my temporary adoption,—far from it; but the Assam roads are undoubtedly superior to the Cachar ones, so far as I have seen; and I am told that the road I know best is better than many others. Cachar bungalows, too, are not quite so far advanced as they are in Assam; but remembering that tea in the former place was fairly started in 1839, and that it was not discovered here until 1855, the district is not so far behind Assam after all.

It has required but a very short time for me to see that Cachar planters go in for much higher cultivation than those in Assam. Shortly after my arrival, in mentioning that, considering the time of year, a certain garden was very clean, I was surprised to learn that for Cachar it was very dirty. It was as well that I learnt this in the youth of my Cachar residence, because otherwise, the state of my garden (probably given in my monthly reports as being fairly clean) would have led to controversy as to what cleanliness really was.

Travelling in Cachar, from one garden to another, is far perferable to doing so in Assam (with the exception of a few places). The "howling jungle" has been subdued here to a very great extent; and the ride from the station leaves but a very few stretches of jungle; the principal scenery being tea. Gardens almost join each other, and the ride is a very pleasant one. The number of bungalows, too, one passes in the vicinity of, prevents the possibility of the traveller suffering from hunger and thirst (especially, I should add, the latter).

If, in other districts of Cachar, opening out has recently been carried on to the extent it has here, I should think it requires but a very short time to lessen materially the existing difference in the tea outturn of Cachar against that of Assam. I have seen a very fair amount of gardens in that province,—especially in one district, where a certain Company is supposed to carry on the largest operations in India; but I must confess that the manner in which land has been opened out here, altogether exceeds anything

I have ever seen or ever heard of. One hill-flat has been opened out, and eight hundred acres planted in two years. In a month or two, another garden close by, now eighteen months old from the first seed planting, will have reached four hundred acres of plant. Another garden of over three hundred acres was made last cold weather; and another, at present fifteen months old, will, in all probability, be four hundred acres by the end of next year. These are but a few instances of what I have seen in a radius of as many miles, and most probably the same thing has been carried on elsewhere. I do not know any garden in Assam where the labor staff of agreement-people would suffice to make extensions of this size; and I may pretty safely assert, that, if in any, only in very few districts could labor be obtained to carry on the opening out of land to such a surprising extent; one or two gardens might do it; but here, many have. There is no secret regarding it; every one will understand that local labor has been tha valuable agents—Nagas, Kookies, Cacharees, and resident Bengalis. Cachar is, indeed, fortunate in being able to command this, for the labor question bids fair to prove the greatest and the most formidable obstacle to a successful continuation of the tea industry in Assam. Last cold weather has plainly taught us the price of depôt coolies from Calcutta; and if the proprietors of these establishments find they can realize so largely upon their labor, sirdars recruiting for gardens will have much to do to compete successfully against the depôt agents. Planters here should heartily congratulate themselves upon having this advantage over Assam. A district fairly supplied with local labor will show a better result than one possessing superior climate and soil, but where the expense of annually recruiting has to be incurred. Another thing in favor of Cachar is the river communication. To the steamer stations innumerable small rivers run, and those long road-journeys for conveying tea in Assam to the Brahmapootra, seldom exist here. As far as I have seen, the natural drainage in gardens, too, is much more satisfactory.

Hills' ("teelahs") differ also. Moderately level land, at a considerable elevation (hill flats) having tea on it, can hardly be compared to tea hills in Assam, which, so far as my remembrance serves me, have very little level space about them. Terracing, too, is largely done here, and although not new to tea, I have but recently seen it for the first time. Many gardens are fortunate in possessing large stretches of Munipore plant,—another new thing to me, as far as the name goes. It resembles exactly in appearance the pure indigenous Assam, as grown from seed taken from the hills by the Nagas; excepting that, for the age, the growth is much greater. Assam planters know the delicate nature of their own indigenous plant, and I leave it to others better informed than myself to decide whether the larger growth of the Munipore plant is caused by a more suitable soil or climate, or what not.

Regarding Cachar planters, I never heard but one opinion of them expressed in Assam, and that was that they were "tea-house men." Prices obtained for Cachar teas exceeding those from Assam occasionally, may have caused this idea; but whether this was the cause or not, I cannot say. I simply mention the fact, because, as far as my residence here has shown me, garden management and cultivation is not left to young assistants, but rather is more generally considered by the head of the factory to be his own particular province.

B.

NOTES ON THE TEA INDUSTRY IN DARJEELING AND KANGRA VALLEY,

With Incidental Observations on Kumaon.

Climate.—Of course it is needless to say that the comparatively hot, moist climate of Darjeeling is more suited for a prolific outturn than the comparatively cold, dry climate of Kangra. We speak of the general condition of the atmosphere, and not of the amount of annual rainfall, which, according to the returns, is much the same in both districts; but the portions of the Darjeeling district nearer the plains get a far heavier annual rainfall than the tea district of Kangra, which is mainly, so far as European gardens are concerned,* confined to the neighbourhood of Palampur. The rainfall in Darjeeling and Kangra varies in one very important respect; the average annual rainfall in Darjeeling being, *cæteris paribus*, greater the nearer the garden is to the plains; while, in Kangra, exactly the opposite is the case, and one constantly sees rain towards the higher hills with none towards the plains. The out-door heat in hot weather is often greater than in Assam, but it only lasts a few hours, and arises probably from two causes:* the fact of Kangra being a valley almost surrounded by hills, which impede to a certain exent the circulation of air; and† the dry atmosphere, which makes the heat at this period so much more trying in the Punjab than in Bengal or Assam. The average temperature, however, is very much less, and the atmosphere during the evening, night, and early morning, is simply delightful.

Land.—In Darjeeling, the native cultivators have no saleable rights in the soil. We do not, of course, refer to leasehold lands held under the Waste Land Rules; but these again are mostly in the hands of Europeans. We believe that the Waste Land Rules for Julpigori and the Bhotan Dooars were drawn up on the principle that after paying revenue for five years, and planting with tea a certain proportion of the area taken up, an alienable transferable right in the whole area should be acquired, though the land is still subjected to the stipulated assessment, which is certainly not heavy; and if the cultivation of tea in the Bhotan Dooars does materially extend, the Government revenue will certainly not, for many years at any rate, prove a heavy item in the expenditure. These precautions were taken to prevent in a measure the operations of land jobbers.

In Kangra, the natives dispose of their surplus land or sell their homesteads at simply ridiculous prices (which in more than nine cases out of ten prove but a mess of pottage, as they almost invariably squander the money as soon as they get it.)

Manure.—The chief manure used in Kangra is cattle manure, and most of the planters keep herds of their own for this purpose, and also purchase as much as they can from the villagers. They have also village rights according to the situation of their lands, and employ the boys on their plantations to collect manure on the pasture grounds adjoining their estates. A boy generally brings in four baskets of about fifteen seers each, or about 1½ maund per diem, for which he receives at the rate of

* The Darjeeling hill tea districts have all variations of temperature and moisture, varying from Punkabarie and Sepoydura, at elevations under two thousand feet, to the station of Darjeeling itself, at an elevation of about seven thousand feet; but the lowest recognised as suitable for tea is about five thousand feet.

† There are two or three gardens near Dhurmsala, three or four in the neighbourhood of Byjnath, which is about eleven miles from Palampur, and one or perhaps two at Shahpur, about thirty-five miles nearer the plains than Palampur.

about Rs. 3 per mensem. The number of sheds erected by the planters to accommodate passing cattle, &c., is surprising. The manure question is perhaps the most serious one in the valley; as the more cultivation extends, the less will be available; and as the villagers understand its value almost as well as the planters, they are by no means disposed to throw it away. Indeed the price asked for it even now is very high.

Artificial manure is, as a rule, too expensive to be thought of, and any oil-cake that can be obtained (which costs about a rupee a maund) is needed to feed cattle. What makes the manure question more difficult is that cow-dung is largely used by villagers for fuel as in the plains.

Manure is necessary in Kangra, not only to maintain the soil in an adequate condition, and to compensate it for what is taken out of it by the tea plant, but to preserve its warmth during the cold weather, which is, compared to Darjeeling, very severe. Any practical plan of increasing the manure supply would be much valued by the planters. *Poudrette* is, for obvious reasons, out of the question, and bone-dust, even if it could be obtained in sufficient quantities, would excite the prejudices and fears of the people, who are, with hardly any exceptions, Hindus; and there are not, as in Darjeeling, ravines with large supplies of vegetable matter washed from the higher forests and other grounds, while the little vegetable matter that could be obtained beyond one's own garden would not pay the carriage.

In Darjeeling (which is not a pastoral country) manure is scarce, but the natives attach little or no value to it, and its price, when procurable, is nominal; indeed we have heard of three or four thousand maunds being delivered on the plantation at one anna per maund.

Wood and Charcoal.—The wood supply in Kangra is, as in Darjeeling, growing scarcer and scarcer every year; and Kangra has not, like Darjeeling, got magnificent forest reserves to fall back upon.

The cost per *tree* in the Government forests in Kangra is less than in Darjeeling; but this may be almost counterbalanced by the difference in the size of the trees and in the quality of the wood. In Darjeeling the wood *par excellence* for tea boxes is toon, which however is growing scarcer every day. The tare of an 80lb. box (Toon) including lead and iron bands, may be set down at from 26lbs. to 28lbs.; that of one of 'Tosht' (the favourite wood in Kangra) at 31lbs. to 33lbs.; or a difference of 5lbs. This, when multiplied by the number of 80lb. boxes required during the season, makes a not inappreciable difference. The other woods used in Darjeeling for box-making are gokul, dukh and uteesh. In Kangra, cheel (fir), much the same as the English deal, is largely used, and semul, the Indian cotton tree, (also existent in Darjeeling, but not, so far as we know, used for box-making there) is occasionally brought into requisition.

For charcoal, almost any heavy wood is good. The favourite in Darjeeling, if it can be obtained at a reasonable distance, is sal; in Kangra the Himalayan oak. The heavier a wood is, the greater and more lasting will be the heat generated, and consequently the less quantity will be required in tea-making. The cost of carriage of charcoal from the forests to the tea-house is at all times very heavy, and may sometimes cost as much as the charcoal itself. In Darjeeling the lowest price at which it is burnt, exclusive of the cost of the wood and carriage, is two and a half annas per maund, (contractors usually charge five annas.) In Kangra it averages between three and a half and four annas per maund; but on the other hand, taking equal distances, the cost of carriage is much greater, as the coolies are able to carry much less. A Darjeeling (Nepaulese) able-bodied man thinks nothing of carrying a hundred

pounds of charcoal up and down steep hills; if a Kangra coolie carries twenty-five seers he considers himself quite a hero.

Opening Out.—There are two classes of land (forest land is too valuable for the purpose) *viz.*, grass lands, and those which have been under previous cultivation for the crops of the country, (rice, wheat, oats, Indian corn, millet, oil-seeds, &c.) Grass land is naturally the more suitable. Rice land, besides the disadvantage of having been previously cropped, and the bulk of its substance taken out of it, has the additional disadvantage of having been soaked annually for months together, and consequently being sour as well as poor. Wheat and oats are grown on the same (rice) lands in rotation with rice. Indian corn, millet and the various oil-seeds, which are however a very small proportion of the crops of the valley, are grown on higher lands, and do not require irrigation, but take a great deal out of the soil.

In opening out, the first thing done after the selection of a site is to dig pits 1½ ft. in diameter, by 2½ ft. to 3 ft. deep, at distances of 3 ft. one way, by 4 ft. the other. This plan is a capital one for assisting the roots of the young plants. The pits are filled in a few weeks before transplanting commences. When the transplanting period arrives a great number of seedlings are planted in each pit. The class of the plant now in the valley may be fairly described as China Hybrid—perhaps the most suitable for the climate, though a little new blood would do no harm. Mass planting appears to have been found to answer admirably in the valley, and those who have gone in for single planting, or planting very few seedlings in each pit, have had to bemoan the slow formation of their bushes. The plan would answer in Kumaon with the same class of plant, owing to the climate being colder, but for the plants of warm moist climates the danger of the roots choking and crushing each other would be very great.

The system of planting nurseries in Kangra Valley, necessitated by the number of seedlings required, is to place the seed in the nursery-beds as closely as they can be placed (touching each other.) This system appears to have been confirmed by the experience of years, and in no district are there, for the numbers, so many experienced planters, several of them having been over fifteen years in the valley; but we cannot help thinking that a little more room in planting would be of service. If the plants were only intended to remain about six months the injury would not be very great, but, after this, seedlings require room for natural growth. We put forward these opinions in conformity with the experience of other districts, with all due deference to the older planters in Kangra valley, and if even fewer seedlings had to be used for each pit on this account, they would, we think, be age for age, larger and with better developed roots.

The bulk of the transplanting is performed at the commencement of the rains, though many do some of it in the cold weather; and if this latter system prove successful, it has the advantage of saving labour for leaf picking, &c., at the busiest and most important part of the year.

Cultivation.—The systems of cultivation in vogue in the various hill districts of India, chiefly vary according to the wants of the individual locality. We think it would be well, for the first year at any rate, merely to keep clear a circle with a radius of about a foot on all sides of the young plant, and if the system advocated with reference to root grasses were adopted, we venture to think that this could be done without much difficulty, as once the soil is loosened round the plant, very little more than hand weeding of the circle would be required with other than root grasses. This is advocated not on account of

any saving of time or expense, which however might possibly be effected, but because the very young plants are thus better protected than is the case when the whole ground is hoed. Of course one would have to prevent, by cutting, the growth of grass in these intermediate spaces, or else merely scrape (except during the rains) them to the depth of a couple of inches after the ring had been cleared. During the rains, save on exceptionally level ground, the ring system (extended in the case of older plants to about double the radius named, which would have two feet on one side, and one foot on the other) would be the only safe one for mature and young plants alike, to prevent the washing away of both soil and any manure that may have been applied.

Manuring.—The amount of manure beneficial to a plant, and the age at which it should first receive it, are questions on which doctors differ. One pound of properly preserved cattle manure to a plant in its second year, from seedling, is about all that a plant of that age could conveniently assimilate, if indeed it could assimilate so much, in one year. Of course the amount beneficial to a plant would go on increasing as the plant approached nearer to maturity: indeed for a very large plant, over eight years old, a whole basket (about fifteen seers) has been known to have been applied with advantage, though we cannot think that a plant of this age, even planted six feet by six feet, could anything like absorb, in one year, this enormous quantity, but it may tend to fertilize the soil for future years. An allowance of seven pounds (say a basket to four bushes) is probably enough for mature plants of any age.

Picking Leaf.—For the first two years, from seedling, all that is necessary in this way is to prevent any shoots running away from the main body of the plant; and in the third year, when picking properly commences, great care should be taken not to overtax the energies of the plant. In Kangra, at any rate, if one gets during the third year from sixty to eighty pounds per acre, and double that quantity in the fourth, it is as much as can be expected, though in Darjeeling one might get one hundred pounds for the third year, and three maunds (two hundred and forty pounds) for the fourth.

We place the average yield of an acre in full bearing in Kangra at rather more than 200lbs. per acre, taking the whole of a large area; though in a small acreage, highly cultivated, and carefully tended, 300lbs., or in exceptional instances even more, might be obtained.

In Darjeeling the average of a first-rate garden making really good tea ought to be placed from four to four and a half maunds per acre; and for an area, say of a hundred acres, the property of an able man, managing on his own account, an outturn of 400lbs. per acre of good tea might reward his exertions.

Of course the amount of tea that could be obtained from a limited area, under special treatment, is more a matter of interest to the curious than of practical value to the planter. The greatest amount of tea we ever heard of being made from one acre of land (belonging to an Association with gardens running from the hills to the Terai) under such special treatment, was nineteen maunds (1,520lbs.) Possibly in Assam or elsewhere a higher result may have been obtained. The different systems of picking leaf now in vogue all have their advocates. Most are in favour of what in Darjeeling is called *Kuppo paro*, (leaving a portion of the lowest leaf plucked to protect the coming shoot); but it is difficult, especially in a heavy flush, to make the coolies follow this system, and pick a proper quantity of leaf, especially as the top of the thumb and top of the first finger can alone be used to do it properly, and these soon get tired when very much has to be picked. It is a great protection, however, from

tearing the leaf off the trees, which coolies are only too fond of doing.

The third leaf often happens to be unsuitable for picking: leave that leaf; but where the shoot has a sufficient quantity of leaves (five or six), not to pick the third is to delay the new shoot, as it (the third leaf) as well as the lower ones on the shoot, have to harden before a free flow of sap can be afforded to the new shoot.

Of course, the finer the leaf that can be obtained without plucking it before it is ready, and thus injuring the tree, the higher price will be obtained for the tea; and considering the high cost of carriage, and the general disfavour that medium and indifferent Indian teas experience in the Home market, our attention must be devoted to the manufacture of really fine tea: but it is very easy to run into the other extreme, and in seeking to avoid the scylla of indifferent tea get (for the reason at any rate) wrecked on the charybdis of making such fine tea that the outturn hardly pays working expenses. Two hundred pounds an acre at fourteen annas a pound will probably leave a profit; one hundred pounds at one rupee two annas will likely, if not inevitably, bring a man on the wrong side of his books. As the main object of the planter, and of those whose capital is invested in the enterprise, is pounds, shillings, and pence, and not amusement or philanthropy, the happy medium must be hit. The most paying tea in Kangra would, as a rule, be what in an ordinary market would be a fourteen-anna tea; and, if this price is not obtained all round, it is hardly worth a man's while to engage in the enterprise, with its attendant risks. In Darjeeling a twelve-anna tea would pay very well; but viewing what has been already stated, a fourteen-anna standard might also be kept in view, and would doubtless, by raising the character of the teas, improve their value, the further and further they were removed from the ordinary run of China tea: and it is from falling into this category that all the Indian hill districts have to keep aloof, if they wish to maintain their distinctive character. It is to the London market that Darjeeling, at any rate, has to look as the purchaser of its teas, as it costs the same to land a tea that fetches fifteen pence, as it does to land one that realises two shillings.

Manufacture.—There is not very much difference in the modes of manufacture pursued in Darjeeling and Kangra, but there are a few, and some of these by no means unimportant ones.

In Kangra the leaf is picked in small baskets capable of containing about two pounds each, and brought in several times a day. In Darjeeling the leaf is (or was till very lately) brought in once a day, (twice in the hot weather) in the evening, in baskets capable of containing a very large quantity of leaf. The leaf is very liable to get spoilt from the results of over-fermentation in the baskets, in spite of all the precautions of managers and assistants to have it turned over sufficiently often during the day. Further, the pressure of a small quantity is not so great, and thus undue heat is not so readily generated. The withering is identical in both places (allowing it to wither all night in as cool a place as possible.)

In Kangra all the operation in the tea-house are performed by tea makers. In Darjeeling rolling leaf (where no machinery is used) is done by able-bodied coolies, the actual tea-making, withering, fermentation, drying, &c., being looked after by tea makers. The Kangra system has the advantage of having men regularly trained to all branches of the work, who are liable to reduction or dismissal in case of misconduct, or bad tea; and when required for other work, they will readily do anything, except hoeing, which they appear to think would compromise their exalted position. The cost of the system is also nominal, as when a tea maker is

first selected he gets an advance of only eight annas *per mensem* on his coolie's pay; and when he gets another eight annas (after, as a rule, about a year in the tea-house), he is fully worth the increase, not only for tea making, but for doing any other work more intelligently; and if need be, superintending leaf picking and other operations.

In Kangra the leaf is rolled in the morning on mats on the floor, then placed in balls, in a blanket inside a basket, for two or three hours (according to the weather) to ferment. Any coarse leaf, of which there is generally very little, is picked out in rolling the first time. The balls are then broken up and panned for a minute or two, and thrown while hot from the pan on tables, generally covered with China mats, and rolled on them for about a minute, when the drying operation commences by spreading out—preferably in the sun, but when this is not possible on account of the weather, over charcoal fires, on oblong mats made of bamboo strips plaited close together on the mats. If there is sun it is preferable that the final touch of the drying process should be given by spreading it out of doors; and it is to this, in a great measure, that the glossy blackness of much of the Kangra tea is due.

In Darjeeling, the leaf (we speak of a year ago), when not rolled by machinery, is hand-rolled once, either on a mat on the floor or on a table (not both) by coolies, each man getting from forty to sixty pounds of 'kucha' leaf to roll, as a day's work. In Kangra, one tea maker is generally allowed, for *all the operations*, to each thirty pounds of leaf. In firing, in Darjeeling, the two systems prevail, the 'chula' and the 'dhole;' and opinion is pretty equally divided as to their merits, but it is to the former of these we have to direct attention. In Darjeeling, the only 'chulas' known are those self-contained, and divided off so that each dries the tea of its own 'chalni.' In Kangra, the general 'chula' is a long masonry trough about the same height as the Darjeeling one, but with no air holes in the front side; and, though this long trough may be divided into sections, this is to prevent a waste of charcoal in case the whole length is not required for drying the day's tea, and there is no such thing as a separate 'chula' for each 'chalni.'

Sifting.—Very little of this is necessary; indeed most of the tea is so good as after cleaning to be classed as fine Pekoe Souchong: indeed it has the advantage of containing Orange Pekoe, Broken Pekoe (which may not have been separated in the drying process) and Pekoe; and as nearly all the Souchong and Congou has been taken out by hand, it is a much finer class of tea than ordinary Pekoe Souchong, deprived of the finer qualities. Indeed to this, in addition to the greater delicacy of flavour, may be due the great appreciation in which the tea is held. When sifting is required, the China sieve is invariably used, and one never dreams of employing the English wire sieve, which seems to have been invented mainly to sell.

The natives in Kangra use home-made sieves constructed either of bamboo, in feeble imitation of the China sieve, or grain stalks, formed into a square, open basket like an English knife-tray. It seems to answer well enough for sifting their coarse Green tea, and as the stalks are round, and not square, there is even less friction than in the China sieve.

Winnowing Machines.—We have seen none in the valley, and hope that there will be no occasion for any in Darjeeling; as the heavier and more solid the tea is, the better it is.

Tea-breaking Machines.—Ditto to the last para.

Tea-rolling Machinery.—Machinery is by many considered a mistake for tea manufacture, in any district where the supply of labour is plentiful, and can be relied upon; and if the Kangra planters ever adopt it,

they will have only themselves to thank if the tea ceases to be so good as it used to be.

Machinery is only a necessity where labour is not available.

Building.—Most of the important buildings in Darjeeling are roofed with corrugated iron, and are built of either 'paka' or 'kachā' brick. The coolies' huts and other temporary buildings are, or were, generally made of bamboo work thatched with grass, though in the long run the substitution of well dried 'kacha' bricks for bamboo work would pay over and over again, and would certainly be equally, if not more, pleasing to the labourers themselves. In Kangra most of the buildings, important and unimportant, are built of 'kacha' brick, and roofed with either slates, or in the case of unimportant buildings, with grass; but the villagers themselves largely use slate for roofing their houses—the blue thin slate, similar to English, and not the great stone slabs, in use in Kumaon. The buildings in the villages there are, as a rule, very substantial.

Tools.—These, as a rule, are the same in both districts.

Labour.—In Kumaon and Kangra the labour is chiefly local and cheap, but that of both places is much inferior both in physique and character to the self-imported labour in Darjeeling from the adjoining districts of Nepaul. In Kumaon a few coolies (and they are the best class in the district) come in from that side of Nepaul. The average rate in Kumaon and Kangra is under four rupees; that in Darjeeling, inclusive of the cost of Sirdari, amounts to five rupees; but an average Nepaulese woman will do twenty per cent. more garden or tea-house work than a Kangra man;—indeed, as far as cleaning tea is concerned, they will do three times as much, and quite as well. There is no very great difference in the size of the Napaulese and Kangara Valley man, but the whole appearance and character is in favour of the former. A Darjeeling coolie thinks nothing of trudging up five or six miles with an 80lb. or 100lb. box of tea, which takes two Kangra men, in a comparatively level country.

Carriage of Tea.—Cost of carriage, per maund nett, from Palumpur to Calcutta, is about seven rupees; that from Darjeeling to Calcutta, varying from five rupees from the station of Darjeeling to about two rupees eight annas from Siligori in the Terai; but a great deal of the Kangra tea is sold much nearer than Calcutta to dealers, messes, and others.

Roads.—In Kangra, with the exception of the Government cart road from Pathankote to Palampur (71 miles), which is a good road, but not a good cart road, the gradients being too varied and steep, the district road from Dhurmsala to Palampur, or rather all the way to Kulu (119 miles), is kept in pretty good repair (in fine weather) as far as Palampur. Plantation roads are comparatively little required, the gardens being smaller and flatter than in Darjeeling, and, as a matter of necessity, more attention is paid to their proper construction and repair in Darjeeling than in Kangra; but the internal roads of the Kangra district are not attended to.

GREEN TEA,

MANUFACTURE OF, IN NATIVE GARDENS IN KANGRA.

THERE are in the Kangra district about eight or nine hundred—possibly a thousand—gardens under native management, varying from a few bushes to many thousand bushes (this is their usual way of calculating the size of a garden.) They almost exclusively confine their attention to the manufacture of coarse green tea, which they sell to travelling merchants (chiefly from Amritsar) without packing or cost of transit, for about nine annas per pound all round.

Their cultivation is very inefficient as a rule; also their modes of picking, treatment of bushes, pruning, storage, &c.

Singularly enough, the native merchants or agents who buy up the native green teas in Kangra, will not look at superior green teas at anything like a fair price, though, I believe, they belong to much the same firms as purchase so largely in Kumaon. There they give about Re. 1 for the good tea, and annas 4 to 5 for Hyson skin and dust.

I believe that the nearer approach a plant is to pure China, and the higher the elevation at which it is grown, the more highly prized its Green tea will be. I have seen, however, tea, grown at precisely the same elevation in Kumaon as the majority of the Kangra Gardens, fetch quite as good prices as any other in the district.

The most extraordinary thing of all is, that Amritsar, the great green tea mart for Central Asia, Cashmere, and the Punjab, is only 138 miles from Palumpur; and Almora cannot be less than six hundred miles; yet the teas are bought up there with avidity, and the Kangra planters do not appear to stand the slightest chance.

The liquor of the Kangra green teas is reddish, and that of the Kumaon (Almora is the native name) teas a delicate green. This may arise from two causes: difference of manufacture, and different soil and class of plant,—probably a combination of both. Indeed, green tea making in Kumaon has been almost reduced to a science. The red-liquor teas are most liked in Cashmere, where in infusing tea they boil it, and add milk boiled down to half its bulk. The price paid for the teas there is from four and a half to five Cashmere rupees (value of rupee about ten annas, per seer, which would give from Rs. 1-10-6 to 1-12-9 per lb. First class Indian green teas in Bokhara fetch rather over five shillings per lb., but a four months' journey has to be taken into consideration.

I think these remarks may interest Darjeeling as well as Kangra planters. I warn them, however, that what in my opinion will nearest compete with China green teas are teas made from China plants at a high elevation; and I do not know of more than four hundred acres of plant in the whole of that district, supposing the chemical constituency of the soil and leaf to be suitable, that would come up to my idea of what is wanted. To make green teas for the Thibet market other than similar to those they are accustomed to, would be money and time thrown away. Exactly the reverse of what will suit the Calcutta and London markets will suit the Central Asian. Of course, even if a road is open through Sikkim to the Thibet frontier, the bitterest opposition will be offered to the introduction of Indian green teas; and we cannot close our eyes to the fact that Thibet is in some sense a tributary of, and under the influence of, China; and that in all human probability it will be years before even five per cent. of the Darjeeling teas could, even if suitable, be introduced. Of course, the greatest undertakings have been commenced under opposition which appeared even more formidable than this, but the enormous amount of *vis inertiæ*, as well as active opposition, that will be offered, may well appal the bravest.

NOTES AND RECOLLECTIONS ON TEA CULTIVATION IN KUMAON AND GURHWAL.

By J. H. Batten, B.C.S., *Retired, formerly Commissioner of Kumaon.* August 1877.

The cultivation of tea in Kumaon has become so important and profitable, that it is interesting to trace the early history of this industry, and the duty of placing on record as true an account as possible of its introduction, rise, and progress, is one which ought not to be neglected by those who are acquainted with the real facts; yet, after all, there is not very much to be told, even by those in full possession of all the *data*, when they attempt to shew that in this case, more perhaps than in any other, belonging to the best interests of British India, the seed of the sower "fell upon good ground, and yielded fruit, some an hundred-fold, some sixty, some thirty."

The history, however, such as it is, may be conveniently and naturally divided into periods, comprising the seasons of, *first*, ignorance and indifference; *second*, guessing and conjecture; *third*, first actual official experiment; *fourth*, regular government exploitation; *fifth*, commencement and progress of private enterprise; *sixth*, abandonment of the official experiment; and, *seventh*, the commercially successful result. Our own recollections more particularly belong to the first four periods.

In regard to the *first* period, we need not be surprised that the tea plant, as a source of future wealth in the British Himalayan provinces, did not enter into the anticipations of the early administrations of those tracts when we find that even the climate, which is now their chief attraction, was treated with indifference. It is a fact that when Mr. G. W. Traill, then an Assistant under the Resident of Delhi, was first offered the appointment of Commissioner of Kumaon in succession to its first British ruler after the conquest in 1815, the Honorable Edward Gardner (promoted to the Residency of Nepal)—he hesitated as to its acceptance on the score of health, and bargained that he might have the option of returning to the plains of Hindostan in case the hills should be found unsuitable to his constitution. If we may not lay too strong a stress on this personal circumstance, we undoubtedly are met by the fact that in his statistical sketch of Kumaon, published in Vol. XVI, of the Asiatic Researches,"* after nearly ten years' experience of the province, Mr. Traill, while alluding generally "to the diversity of temperature and climate found at various degrees of elevation on the mountains, drew up for public information his tabular statement of the thermometrical range (which he described as indicating a "moderate heat,") from observations made in the valley of Hawalbagh at 3,887 feet above the sea. Almorah at 5,400 feet remained for many years the highest of the English hill stations.† and was quoted as the only Sanatarium by Bishop Heber in 1824, while Dehra in the Dun of that name in Gurhwal, and Sabathu in the north-western mountains, both of them situated in almost sub-tropical climates, owing to their low elevation, were the head-quarters of the Civil and Political Officers, then undiscerning the future sanitary and social importance of Major Young's "*potato garden*" at Mussooree, and Captain Kennedy's "*hot-weather bungalow*" at Simla. Nor, while regretting the delay which has occurred in the introduction of the tea plant into Kumaon, need we be accused of any unfair or captious display of what may perhaps be called "wisdom after the event" in pointing to the following facts, *viz.*, that Naini Tal, now the beautiful summer seat of the government of the North-West Provinces, was only discovered and established as an European station in 1843-44; that Ranikhet, now a large European military cantonment, was only known, until very recently, as forming part of the Choumoka Devi range, visited by Bishop Heber in December 1824; that the much-dreaded malarious Bhabar and Terai, at the foot of the Kumaon mountains, formed a real and actual barrier to all intercourse, except that of the letter post every year, from April to November, but are now constantly traversed in comparative safety by European travellers, and afford a principal source of revenue to the Kumaon exchequer, under the able management of Sir Henry Ramsay, the present Commissioner; that the resort of English men, women and children to the mountains, formerly feared as somewhat of an invasion and visitation, has become a constantly increasing source of wealth and civilization to the "poor Paharris," and that, at the present date, the price of borax from Hundes, in the Almorah bazar, has almost ceased to be mentioned as a trade speculation, whilst the price of Almorah tea has become an important topic of conversation amongst the merchants of Cabul!

As these notes are specially devoted to the subject of tea in Kumaon and Gurhwal, we need not concern ourselves with the general *speculations* as to the growth of the tea plant throughout the Himalayan districts, or elsewhere, which the valuable paper on tea culture, read before the Society of Arts, by Mr. A. Burrel, on February 2nd, 1877, may be said to exhaust. But we may be permitted to remark that, looking to botanical facts, which shew no true Thea or Camellia growing wild in the mountains west of Sikkim, it is highly probable that the specimens of Thea sent from Nepal in 1816 to Dr. Wallich, Superintendent of the Botanical Garden at Calcutta, by the Honourable Edward Gardner, belonged to Chinese plants, flourishing in the Residency or other gardens at Khatmandu—a by-no-means extraordinary introduction, considering the political relations existing between China and Nepal. We may, also, observe that the traveller Moorcroft, whose deputation to Cashmir and Thibet took place in 1819, and whose special vocation was to look after horses and wool, when mentioning the "tea of Bissahir," and comparing it with the "coarser teas of China," fell into the mistake of supposing that the tea plant grew on the banks of the Sutlej.

Bishop Heber, who visited Almorah in December 1824, and, as previously glanced at, on his return tour to the plains, passed the site of the present cantonment of *Ranikhet* by the route of the Riuni, Kumhpur and Choumuka Devi range,* wrote the following words in his journal:—"The tea plant grows wild all through Kumaon, but cannot be made use of, from an emetic quality which it possesses. This perhaps might be remedied by cultivation, but the experiment has never been tried. For the cultivation of tea I should apprehend both the soil, hilly surface, and climate of

* *Vide* page 15, Official Reports on the province of Kumaon (Agra, 1851).

† The remote frontier post of Kotgurh, overhanging the Sutlej valley in the western hills, though well known as the residence of the two Gerrards, who were among the first to explore and describe the Himalayan regions, is certainly higher in elevation than Almorah and its outposts, but it could not properly be called an English Hill Station.

* As bearing on our present subject, it is somewhat singular that the principal site, originally selected for this military station, was tea-garden belonging to the Troup family, the members of which have been, from the first, conspicuous private tea-growers in Kumaon.

Kumaon, in all which it resembles the tea provinces of China, extremely favourable."

This latter remark shows the observant eye, and prophetical wisdom of the good Bishop, and fully entitles him to an honourable place, perhaps the first, on the list of tea pioneers in Kumaon, but the former statement was founded on a "vulgar error." It is now well known that the plant alluded to is a species of *Osyris*, belonging to the natural order Santalaceæ, and it is as well to record in this place that in the *Transactions* of the Committee of Commerce and Agriculture of the Royal Asiatic Society of London in 1838, Dr. Royle states that "some specimens of the tea Bishop Heber referred to had been obtained by the Hon. Mr. Shore, from Mr. Traill, then Commissioner in Kumaon, and were found to be the dried leaves of *Osyris Nipalensis*, and produced a very disagreeably tasted nauseous infusion when used as tea."* The indigenous tea, therefore, of Kumaon must we fear take its place, in spite of episcopal authority, among the rosemary and nettle and other teas of our rural English housewives. Before closing this subject, we may add that the nearest ally to Thea in Kumaon is a species of *Eurya*,† belonging, according to Lindley, to the same natural family the "Ternstromiaceæ," but undoubtedly not the tea-plant.

Amidst all these *guesses and conjectures*, the first real land which we descry in the history of Kumaon tea is the appointment, on 24th January 1834, of Lord William Bentinck's "Committee for the purpose of submitting a plan for the accomplishment of the introduction of tea culture in India, and for the superintendence of its execution." This Committee* circulated important queries, and among the botanists and scientific men aroused by the inquiry, there happily appeared Dr. HUGH FALCONER, Civil Assistant Surgeon of Shaharanpur, in the North-West Provinces, then in charge of the Government Botanical Gardens at that station, and eventually the successor of Dr. Royle in that appointment. His ardent mind was at once aroused to the great importance of the subject as affecting the Himalayan districts which overhung the scene of his official labours.

The mantle of Royle had indeed fallen on worthy shoulders. If to that eminent naturalist at Shaharanpur and to Wallich at Calcutta, presenting reports and urging arguments in the proper quarter between 1827 and 1834, we owe that formation of the Tea Committee in the latter year, which we have just ventured to name as the era from which to count our Indian tea chronology, it is to Falconer that the Kumaon and Gurhwal tea growers may undoubtedly look back as the founder of *their* history. We well remember on arriving at Shaharanpur in January 1835, our own delight at our first introduction to this eager and enthuasiastic votary of science. At that time of course, the treasures of the Sewalik fossil ground were earliest displayed to our admiring eyes, and *Cautley*, *Durand* and *Baker*, officers belonging to the Jumna Canals, were joined with *Falconer* in the enlightened circle† belonging to that small, but interesting station, and its neighbour Dadupoor; but geology was far from being the sole topic of animated discussion, and Falconer was full of his recent visit to the mountain country between the heads of the Jumna and Ganges, and of his hopes of permanently introducing the true tea plant, not only there and in the Dehra Dun, but also in the district between the Ganges and Gogra, forming the British province of Kumaon. Our own earliest lessons in Himalayan botany and geology were there taught us in Falconer's happiest manner, and the sight again of his MS. Journal then shewn to us, with which we have just been favoured, brings our thoughts vividly back to those instructive days, and sadly reminds us that, in 1834, as in following times, and alas! to the very end, attacks of illness cut short, or diminished the extent and usefulness of his most important tours of scientific enquiry. Much of the ground traversed and described in that Journal of 1834 was gone over by ourselves in 1135; and, knowing the anxiety of our friend in the subject, we recollect our dissapointment in

* The late Captain Edward Madden, Bengal Artillery, subsequently better known under the name of Major Madden, as the author of numerous highly interesting botanical and other notes of his tours in the Himalayan districts, and more particularly in Kumaon, published in the Journal of the Bengal Asiatic Society in the years 1847-48-49, writes thus in his "Brief Observations on some of the Pines and Coniferous Trees of the Himalaya," printed in Vol. IV. of the Journal of the Agricultural and Horticultural Society of India at Calcutta (1845):—"Dr. Royle mentions that in Kumaon tea is made from the leaves of Shrub *Osyris Nipalensis*, and this is probably the green tea of Bischur which Moorcroft (Travels, I. 35, 2.) describes as being imported into Ladakh under the name of *Maun* or *Bisehur* tea, the produce of an evergreen shrub, 4½ feet high growing on a dry soil in Kooloo and Bisehur on the banks of the Sutlej, and specially about Jhagul between Rampoor and Seran. The leaves are gathered from July to November, and after infusion in hot water are rubbed and dried in the sun. They sell at the rate of three seers per rupee, and are not much in request. The first infusion is reddish and is reckoned heady; the second which is used is yellowish green. The *Osyris Nipalensis* grows to be a large shrub ten or twelve feet high in the Kotar Khud above Subathoo and between Kussowlee and Kalka, where it is called Krecoontee, Kooontee, and Kuueentee, and also Loonkt. The fruit is known by the name of Peopla or Peopra, also applied to that of *Murraya exotica*. The natives here use the leaves medicinally, but not, I believe, as tea. The black tea of Bisehur, Moorcroft describes as the produce of a deciduous shrub found near Usrung and Leehee in Kunaur; of which the leaves are pulled in July and August. Usrung is very elevated for a species of rhubarb flourishes in the neighbourhood."

† In Major Madden's Kumaon Botany *Eurya acuminata* is mentioned more than once.

* Among its members was Sir Robert Colquhoun, Bart., formerly Commandant of the Kumaon Local Battalion, and Civil Assistant to Mr. Traill, the Commissioner; frequently, with lady Colquhoun, mentioned by Bishop Heber in his journal.

† The future world-wide distinction of this circle was not confined to Canal Officers and men of natural science; for the coming hero, Lord Napier of Magdala, then a young Lieutenant, was Civil Executive Engineer at Shaharanpur.

finding at one garden—Rama Surai* in the heart of the Tirhi Rajah's territory—that the tea seeds sown by the Shaharanpur gardener had not yet successfully germinated.

To return to the Tea Committee. The report† received by that body early in 1834, from Dr. Hugh Facloner, was acknowledged as leading them to adopt the sub-Himalayan regions‡ as entirely suitable for the projected culture, and so rapidly was this followed by action, that their deputed secretary, Mr. Gordon, was able to send to them from China a large supply of seeds of the true Bohea tea, which, early in 1835, besides being despatched to Madras, Mysore, the Neilgherries, and Assam, were distributed in Foreign Gurhwal (Tirhi), the Dehra Dun, Sirmur, and Kumaon.

It was extremely fortunate for the cause of which we are treating that the Commissioner of Kumaon, in 1834, was Mr. George William Traill. This gentleman, as shewn by his published statistical reports on Kumaon and the Bhote Mehals, and by his great reputation as a Local Administrator, was eminently qualified to appreciate the economical importance of the tea question, and to give effect to any suggestions of the Tea Committee. It was also fortunate that he possessed on the spot an able coadjutor in Mr. Robert Blinkworth,§ who held at Almorah under Dr. Wallich, as he had previously held in Nepal, the appointment of Plant Collector for the Botanical Garden of Calcutta. On receiving the report of the Tea Committee, Mr. Traill at once understood the conditions under which the Chinese tea plant would be most likely to flourish in his province; and he selected two most appropriate sites for sowing the Tea Committee's seeds. All subsequent experience has shown that, as a general rule, he was quite right in the grounds of his selections—climatic and otherwise—and that any *extreme* departure from those grounds has been subsequently found to be unfavourable to the success of the tea experiment. These sites were Latchmeswar, near Almorah, and Bhartpur, near Bhimtal, the former occupying three acres of old and easily acquired Crown garden|| land on the north-west slope of the hill below the capital town at 5,000 feet above the sea, the latter occupying four acres at 4,500 feet above the sea, in the near neighbourhood of the Bhimtal Lake, which is situated on the first step of the mountains above the Bhamauri Pass. To these two sites the Kumaon official experiment was confined during the six quiet years following the eventful period of 1834-35. The close of 1835 witnessed the departure to Europe of Mr. G. W. Traill,* the Commissioner, to whom the province of Kumaon owes so much. "His name will live for ever among the posterities" the descendants of those grateful Paharries, in whose memory their earliest British ruler has been associated with the blessings of peace, kind dealing, and good government (blessings unknown under the hard rule of these Goorkhas), if not with that increase of wealth and civilization, moral and material, which, with the advance of the times, has marked the administration of his successors.†

It is proper to confess that at Latchmeswar and Bhartpur the growth of the tea-plants was left very much to Providence, and—Mr. Blinkorth; and that no very sanguine anticipations or anxious inspections disturbed the tranquility of the Kumaon authorities in regard to tea. It was seen, as a matter of ocular evidence, that the plants flourished in those two nurseries; and perhaps the first favourable circumstance connected with them and their seed-pruduce was, that many travellers, through the province, had opportunities of observing the tall flower covered, and seed-laden tea trees growing in Mr. George Lushington's garden at his beautiful country residence of Ritea Sen,‡ at Soniana, in Lohba, 50 miles to the north-west of Almorah, on the borders of Kumaon and Gurhwal. Similarly, visitors to the Shaharanpur Botanical Garden were shown live tea tree plants, the offspring of seeds from the small patch of nursery ground at Koth, in Foreign Gurhwal.

At Paori, too, the official residence—it can hardly be called the "civil station"—of the Senior Assistant Commissioner in charge of the British portion of Gurhwal, situated on the north side of the range overhanging the old capital Srinuggur—very fine tea plants were growing in considerable numbers. At length, in the spring of 1841, Dr. Falconer himself paid a visit to Kumaon, and the regular formation and further extension of the Kapina nursery at Almorah which Mr. Blinkworth had commenced in the immediate vicinity of Latchmeswar, and, like that plantation, having its nucleus in an old grown-plot of garden, was the first result of his personal inspection of the country. We well remember his hearty approval of the wisdom which had led Mr. Traill and Mr. Blinkworth to select the ori-

* Subsequently one of the most favourable, though small, sites of tea as reported by Dr. Jameson in July 1847.

† 22nd February 1834.

‡ That is, "the lower hills and valleys of the Himalayan Range."

§ A name not unknown to the nomenclature of the Himalayan Flora.

|| Raj-barhi.

* Mr. Traill was a member of the well-known Orkney family, and possessed landed property in those islands, but he preferred to lead a quiet life among old Indian friends in London, and he died suddenly at the Oriental Club in November 1847 . . . . Among his heirs and representatives is Sir Edward Colebrook, Bt., M.P., the present President of the Royal Asiatic Society, the worthy son of a distinguished father, and himself in early youth, like Mr Traill, a member of the Bengal Civil Service.

† 1836-37, Colonel G. E. Gowan, Bengal Artillery; 1838 to 1848, Mr. G. T. Lushington, B.C.S.; 1848 to 1856, Mr. J. H. Batten, B.C.S., formerly Assistant Commissioner; 1856 to 1877, the present Major. General Honourable Sir Henry Ramsay, C.B., C.S.I., formerly Assistant Commissioner.

‡ Now a tea plantation belonging to Mr. J. Richards.

ginal tea sites; but it is fair to confess that Falconer, quite as much as his successor, Dr. W. Jameson, at first strongly desiderated tea sites in more flat, and more easily and plentifully irrigated and irrigatable land.

The extension of the official experiment to the rich slopes adjacent to Naukurchia Tal, the sister lake of Bhimtal, not far from the Bhartpur plantation, followed in rapid course; and early in 1842 the Government was able to send to the Calcutta Agricultural and Horticultural Society the following cheering notices supplied by Falconer representing the progress already made in the cultivation of the tea plant in the provinces of Kumaon and Gurhwal:—

"The first place in which the plant may be seen is Paori, near Srinuggur, at an elevation of about 6,000 feet,* where there are some hundred strong and healthy-looking plants and seedlings. The next place is in a garden at Lobha; here, at a height of about 500 feet, are about as many plants, as at Paori, and all of the same healthy appearance. At Almorah there are two gardens belonging to Government; the first covers three acres, and contains 1,500 full grown trees yielding seed, and 20,000 growing seedlings. The second stands on eleven and a half acres, and has 700 layers and 500 seedlings. The most eligible sight nearest the plains is at Bhimtal, where there are two gardens; Bhartpur, of three acres, contains 300 trees yielding seed, 700 layers, and 200 seedlings; the other, Russeah, on the Nowkoorcha Lake of six acres, has 5,846 thriving seedlings, and 20,000 seed sown. In the vicinity of this last garden, in the semi-circular slope of the mountain to the north and east of the Nowkoorcha Lake, a great extent of irrigatable land, proved to be favourable to the growth of the tea plant, is to be had at the distance of only one march from the plains, and at an average elevation of about 4,000 feet. In the several gardens, not of too recent formation to have trees yielding seed, there are calculated to be not less than 60,000 seeds nearly ready to be gathered, and that nearly all of these will germinate, may be concluded from the produce of what have last year been sown, and are now coming up. On the whole, the experiment, in as far as the possibility or rearing the tea plant in the provinces of Gurhwal and Kumaon is in question, may be safely pronounced to have completely succeeded."

This quotation brings us naturally to the close of our period of *first official experiment*, and we now enter upon the period of *regular Government exploitation*;† and at this point of time the figure of Hugh Falconer begins to recede from our view. But before ill-health compelled him to leave Shaharanpur in December 1842, he had accomplished the main object which he had always in view, and proved the success of the experiment which had been initiated under his auspices, by the production of actual manufactured Himalayan tea. He had concluded his report on the state of affairs in Kumaon, at the close of 1841 by the following recommendation: "I beg, therefore, strongly to recommend this to the favourable consideration of Government, that two complete sets of Chinese tea manufacturers be supplied for the nurseries at Kumaon and Garhwal, special care being taken in the selection that these workmen be of the best description." In consequence of that application,*—"the Indian Government determined upon sending him a small manufacturing establishment. The black and green tea manufacturers, however, who were engaged for this purpose by the Commissioner of Assam, subsequently declined, together with their Superintendent, to proceed to Kumaon. Dr. Wallich was fortunately enabled to procure other men in Calcutta out of a party of Chinese artizans returned from Assam. A set of manufacturing implements were also procured from Assam. These were forwarded to Kumaon in charge of Mr. Milner, the gardener, who was on his way to the Botanic Garden at Shaharanpur. The Chinamen (nine in number) arrived at their distination† in April 1842."

These men made some tea from the Kumaon plants in the autumn of that year, and Dr. Falconer, who had been detained in the south of Europe by ill health, brought a specimen of the manufacture to England in June 1843. As shown in Dr. Royle's report just quoted, it was submitted for examination to the eminent tea brokers, Messrs. Ewart, MacCaughy, and Delafosse, and their report of 8th September 1843 is thus worded: "The tea brought by Dr. Falconer as a specimen of the growth of the China plant in the Himalayan Mountains resembles most nearly the description occasionally imported from China under the name of Oolong. This resemblance is observable in the appearance of the leaf before and after infusion. The color of the liquor is also similar, being paler, and more of the straw color than the general description of black tea. It is not so high flavored as the fine Oolong tea with which we have compared it, and has been too highly burnt in the preparation, but it is of a delicate, fine flavour, and would command a ready sale here." We ourselves well remember the arrival of the Chinamen; and in our printed account of Almorah, in June 1843, where we described the beauty of the scenery at Hawulbagh, and recorded the fact that Major Corbett's large estate at that place had been purchased by Government, and our

* This elevation is not correct. The height of Paori is about 5,250 feet.

† Dr. Falconer, on 2nd May 1836, forwarded to the Secretary of the Tea Committee, at Calcutta, a *very full* Report on the five experimental tea nurseries which he had established in Gurhwal (Protected State) and Sirmur (Protected State), and on the condition of the tea seeds which he had received from Calcutta.

* *Vide* Report on the Progress of the China tea plant in the Himalayas, from 1835 to 1847, by J. Forbes Royle, M.D., F.R.S., London, April 1849, Journal of the Royal Asiatic Society, Vol. XII, Part I.

† Hawulbagh, near Almorah.

hopes that under the superintendence of Dr. Jameson, the *horticultural* garden would yield large supplies of fruit, such as apples, pears, and plums, of better quality than then existed, we added, "Thousands of tea plants are thriving very well in the Almorah and Hawulbag nurseries, and Chinese Tea-bakers amuse the paharree population by their strange figures, and still stranger propensities."*

It is no disparagement of Falconer's merit that it was subsequently discovered that these first imported artizans were not all of the right sort from the best tea districts of China, or that Dr. Jameson, who had relieved Falconer during the serious illness of the latter, had, as it would appear, also sent specimens of manufactured tea to Calcutta and London, and received a favourable report thereon in September 1843 from Messrs. Thomson of Mincing Lane.

We now come to the great *central name* which will always most justly be associated with the immense success which has attended the progress of tea culture in the mountain districts of India. WILLIAM JAMESON had not to make a name for himself. He came to India with all the *prestige* derived from the reputation in science of his celebrated uncle, and right nobly has he sustained, and extended from Edinburgh and Europe to the Himalaya and Asia, the honors of his family.

Having assumed full management everywhere as Superintendent, Dr. Jameson paid his first visit to Kumaon, in April 1843; and made his first official Report† on the tea nurseries of that province on the 28th February 1844. From that date until the abandonment of the Government exploitation, and the successful establishment of private enterprises, the progress of the whole cultivation of the tea plant, and of the production and disposal of the manufactured tea formed the subject of the most complete and exhaustive reports, furnished regularly by the Superintendent, and published at first in the "Transactions of the Calcutta Agricultural and Horticultural Society;" and after the introduction of the system of Annual Administration Reports by the several Governments of British India, in the official records of N. W. Provinces. It is no business of ours to transfer the statistical details thus furnished to the pages of these Notes and Recollections. We trust that they will be collected and embodied in one general history, either by Dr. Jameson himself, or by some other competent authority. But the following observations, founded on personal experience connected with the *earlier* reports, will not, we humbly think, be out of place.

With the exception of the garden at Hawulbagh, which, with its fine house and offices, were purchased by Government at a most convenient and critical period in the history of the experiment of which we are treating, and which became the head-quarters of Dr. Jameson in Kumaon, and the site of the principal factory,—the new ground taken up for the first great extension of the tea nurseries was not all happily chosen. At that time a *copious* supply of water for irrigation of the tea plants was considered essential to their welfare, and Dr. Jameson, in his additions to the original plantations in the Bhimtal district, only carried out the selections and intentions of his predecessor. Russeah Kooa Sar, and Anoo Sar, especially these last, as their names imply, were situated in essentially *valley* land. The natives of Kumaon divide all land into *ooperaon*, or high, and *tulaon*, or low, which last division also includes *seera*, or actually wet or irrigated soil; and the original recommendations of the Tea Committee certainly did *not* point to the latter. But these nurseries also had another defect. They for the most part occupied land which the villagers of the Chuckhatta district preferred to keep in their own occupation, and official pressure was undoubtedly used before the landowners agreed to take what was considered a compensating rate of rent.

We ourselves at that time filled a subordinate position; and in handing over wheat and rice lands for the planting of tea, we only acted under the orders of superior authority. But nevertheless, in our civil executive capacity, our hands, as duly recorded by Dr. Jameson, did deal the fatal blow, and we do not now wish to deny our responsibility; but the whole thing was a mistake, and we ourselves, some time before we resigned the Commissionership to its present philanthropic incumbent, having been instant in season and out of season in personally representing to the head of the local Government the claims and wishes of the Zemindars, had the great satisfaction of restoring to them their lands, and receiving their thanks. On this matter Mr. Robert Fortune, the celebrated gardener-traveller, to whom English florists owe so much, in his first report on the condition and prospects of tea cultivation in the North-West Provinces, dated September 6th, 1851, after objecting to the "low flat land" as unsuitable for tea, remarked: "Besides, such lands are valuable for other purposes. They are excellent rice lands, and, as such, of considerable value to the natives." And in his second report, in 1856, he made the following observation: "In my former report to Government, it was necessary to express an opinion on some other plantations in this district, where the land, which had been chosen, was not suitable for tea. Since that time these plantations have very properly been abandoned, and the land returned to the natives for the cultivation of rice and other crops, for which it is well adapted." We have no wish to revive the controversies raised by what may be called the "Fortune Episode" in the

* Among them their love of pork.

† Communicated by Government N. W Provinces to the Agricultural and Horticultural Society, Calcutta, and published in their Journal Vol. II, No.

general history of Himalayan tea; but in recounting our own experiences on the subject of Kumaon tea in particular, it would have been almost dishonest to have maintained a complete silence on the *vexata quæstio* of moist and dry sites, or to have omitted some mention of the only remarkable official mistake committed in the course of the Government exploitation which at last culminated in such brilliantly successful results.

Putting aside the point of controversy, which, after all, chiefly referred to a temporary state of the Kaolagir* plantation in Dehra Dun, the earlier deputation of Mr. Fortune to the tea plantations—a most important and beneficial event in the history of Indian tea, being made by one thoroughly acquainted with China—brought to proof quite as much as did his second, the very great *impetus* which had been given to the spread of the plant by the energetical efforts of Jameson.

We ourselves, after the lapse of twenty-six years, still remember with the liveliest pleasure the visit of Fortune to Kumaon in 1851, and the enjoyment and profit we received from his interesting and instructive conversations at Naini Tal and its vicinity; while of course, it was satisfactory to ourselves, then filling the principal official post in the province, to find that he sympathized with our own views as to the future sites of tea† in our districts.

We had been a little disappointed by the result of a visit paid by Dr. Jameson in the autumn of 1846 to our pet tract, Kutyoor, concerning which he reported in July 1847:—"I accompanied Mr. Commissioner Lushington to Byznath, being informed by him and Mr. Batten that in its neighbourhood a large tract of country, well adapted to tea cultivation, was lying waste. Such, however, no doubt, was the case prior to the last settlement; now all the irrigable land is covered with rich cultivation. I must, therefore, extend the plantations in the Chukhata district." It was with corresponding satisfaction that we found Mr. Fortune in 1851 fully alive to the great importance of Kutyoor as a tea district, and we cannot refrain from quoting at length his recorded opinions on the same subject:—Kutyoor is the name of a large district 30 or 40 miles northward from Almorah, in the centre of which the old town or village of Byznath stands. It is a fine undulating country, consisting of wide valleys, gentle slopes, and little hills, while the whole is intersected by numerous streams and surrounded by high mountains. The soil of this extensive district is most fertile, and is capable of producing large crops of rice on the low irrigable lands, and the dry grains and tea on the sides of the hills. From some cause, however, either the thinness of population or *the want of a remunerative crop* large tracts of this fertile district have been allowed to go out of cultivation. Everywhere I observed ruinous and jungle covered terraces, which told of the more extended cultivation of former years. Among some hills near the upper portion of this district, two small tea plantations have been formed, under the patronage and superintendence of Captain Ramsay, Senior Assistant Commissioner . . . . I never saw, even in the most favoured districts of China, any plantations looking better than these."

In our own Settlement Report, written in 1846, which will be found printed in the *Kumaon Official Reports* published by the Government of the N. W. Provinces, Agra, 1851, we had stated as follows:—"At one time from the citadel of Runchoola above their capital Kutyoor, the ancient rulers of the hills must have looked down and around on an almost unbroken picture of agricultural wealth, for not only in the valleys, but up three-fourths of the mountain sides, now covered with enormous forests of pine . . . . the well-built walls of fields remain in multitudinous array, terrace upon terrace, a monument of former industry and populousness, and only requiring the axe to prepare an immediate way for the plough. The valley of Byznath being situated on the frontier of Kumaon, with Gurhwal, and in the neighbourhood of Budhan Fort, was often, in all probability, the scene of border conflicts and military exactions, and the desertion of villages having once commenced, the deterioration of climate, originating in the spread of rank vegetation and the neglect of drainage, &c., may be supposed to have gone on from worse to worse, till finally the heat and moisture were left to perform all their natural ill-offices, unchecked by the industry of man. Viewing, however, the present slight improvement in a hopeful light, and remembering the less favourable situations in which nurseries are thriving, *we are of opinion that the district of Kutyoor* (Byznath) *would be found the one most deserving of selection for the future spread of the Kumaon tea cultivation.* Irrigatable unoccupied lands, at between 3,000 and 5,000 feet above the sea, abound on the lower slopes of the hills, while much of the good land in actual possession is occupied by migratory tenants-at-will, unattached to the soil, in whose place the Pudhans of villages could have no reasonable objection to see profit-paying, wealth-planting *gardeners*." In another place, after describing the desolation caused by tigers in the neighbouring pergunnah of Gungolee, and after showing the small amount and precarious character of its revenue, and the faci-

* Formed by Dr. Jameson in 1844, and sold to the Rajah of Sirmur (Nahn) in 1867.

† Among other remarks in his first report occurs the following:—"There is no such scarcity of tea land (*i.e.* 'the hilly land, such as the tea plant delights in) in these mountains, more particularly in Eastern Gurhwal and Kumaon. It abounds in the districts of Paori, Kunour, Lohba, Almorah, Kutyoor, and Bhimtal; and I was informed by Mr. Batten that there are large tracts about Gungolee and various other places equally suitable. Much of this land is out of cultivation, while the cultivated portions yield on an average only two or three annas per acre of revenue."

lities for obtaining waste lands, we added—"We have named this pergunnah as one of those most favourable for the tea-growing experiment. We do not fear the expulsion of well-armed, and what is better, well-paid malees from their fenced nurseries by the combined efforts of all the *feræ naturæ* of Gungolee." We may, we trust, be permitted to look back with pride to these and other similar vaticinations of our own in regard to Kumaon tea, when in 1877 we are able, in recording our recollections of our "antiquæ sedes," to point to the long list of flourishing tea plantations in Kutyoor, and now, on the earliest possible occasion, publicly to thank those of the existing Kumaon planters who have given or sent to us *their* thanks for having been the first to declare the suitability of the sites now occupied by their estates, and to prophesy their future wealth. But our own greatest triumph, and the main cause of the present prosperity, are to be found in the fact—one most kindly and hospitably brought before our own eyes in 1865, when we took leave of Kumaon during a final visit from our last Indian station, Agra,—that Dr. Jameson himself established* a principal nursery and factory at Aya Tolee, near Byznath, which became the centre of the best and richest tea district in Kumaon.

We cannot close this paper without adding to the names, which, in these notes, have been mentioned in connection with the introduction and progress of tea in Kumaon and Gurhwal, the distinguished name of Sir John Strachey, the present Financial Minister of India, lately Lieutenant-Governor of the N. W. Provinces, and for ten years of his younger life, a most important member of the Kumaon Civil Commission. We are not conscious of any undue partiality caused by family ties, when we state our conviction that the hill provinces owe an immense debt of gratitude to him. If science owes to his well-known and able elder brothers, Colonel Henry Strachey and General Richard Strachey, the pioneer development and elucidation of all that is most interesting in the geography and geology of the Himalayan regions, belonging to, or adjacent to Kumaon,—with no less distinction will the words *progress and light* be always associated with the name of John Strachey, in the civil, moral, intellectual, sanitary, and material history of Kumaon and Gurhwal.*

In conclusion, as the very best commentary on all that we have been telling, we append to this paper the list of the private plantation in the Dehra Dun, which accompanied the admirable official memoir on that district in 1874 by Mr. G. R. C. Williams, Bengal Civil Service, and a similar list for Kumaon and Gurhwal in 1877, which we have recently received from Almorah. Verily, the few seeds sown in those early diminutive plots in Kumaon and Foreign Gurhwal in 1835, under the auspices of Traill and Falconer, have produced abundant fruit.

* Under orders of Lieut.-Governor, N. W. Provinces, dated 31st July 1854.

* As bearing on our own particular subject, the "Notes on the cultivation of Tea in Kumaon and Gurhwal," written by J. Strachey, Esq., Senior Assistant Commissioner, Gurhwal, dated 30th May 1854, and printed by the Government N. W. Provinces, among other papers of that year at their Agra Press, may be referred to as communication of the highest value.

List of Plantations in Kumaon and Gurhwal, 1877.

Furnished by H. G. Batten, Esq., Extra Assistant Commissioner.

Alphabetical Name of Concerns.	Name of Gardens.	Proprietors.
1. Berenag ... ... (In Pergunnah Gungolee, Puttee Buraon)	Berenag ... .. Purana Thul, Peerpulte	W. J. Galway. S. Carrington and J. Isaac.
2. Cheerapanee ... ... (In Pergunnah Kalee Kumaon, Puttee Tulla Charal).	Cheerapanee ...	Major C. A. de Kantzow.
3. Chowkooree ... ... (In Pergunnah Gungolee, Puttee Buraon).	Chowkooree Chinnatee	J. G. Bellairs.
4. Doonagiree ... ... (In Pergunnah Palee, Puttee Mulla Dwara).	Doonagiree	Craw & Co.
5. Dr. Oldham's Tea Gardens ... (No. 1, at Hawulbagh old Cantonment, near Almorah No. 2, in Pergunnah Chukata, near the Bheemtal Lake, and all the remainder in the great Tea District of Kutyoor to the north of Almorah).	Hawulbagh Lines Bheemtal Nowghur Lucknee Burgwar Mulla Dhoba Tulla Dhoba Downee Nurguaree Pitlakote Whendra	T. Oldham, Esq., LL.D., F.R.S., F.G.S., &c.

Alphabetical Name of Concerns.	Name of Gardens.	Proprietors.
6. Dumlote ... ... (In Pergunnah Kutyoor).	Dumlote	R. M. Dalzell.
7. Fernhill ... ... (In Pergunnah Kalee Kumaon, Puttee Bisong).	Fernhill	Col. J. J. Dansey.
8. Government Tea Gardens ...	1. Aya Tolee ...	1. Messrs. C. & N. Troup.
	2. Hawalbagh ...	2. Motee Ram Sah.
9. Gwaldum ... ... (In Pergunnah Budhan, Zillah Gurhwal).	1. Gwaldum ... 2. Cheringa ...	T. A. Warrand.
10. Jhultola and Sunoodhiar ... (No. 1 in Puttee Buraon) (No 2 in Puttee Kumsyar, Pergunnah Gungolee).	1. Jhultola ... 2. Sunoodhiar	Moonshee Etmam Ali.
11. Kousanie Tea Co., Limited ... (In Purgunnah Kutyoor).	Kousanie	Kousanie Tea Co.
12. Kumaon and Kutyoor Tea Co. ... (In Pergunnah Kutyoor)	1. Wagoola ... 2. Megree, &c.	C. J. R. Troup. Sir R. J. Meade, K C.S.I. Major D N. Murray. Col. W. H. Hawes. Col. H. J. Hawes. Col. J. P. Waterman. Capt. G. W. Cockburn. Major C. H. Hinchcliff. N. F. Troup. Col. A. S. Smith. Capt. G. S. Tait.
13. Lockington ... ... (In Pergunnah Kutyoor)	1. Chuttyeo ... 2. Bronga ... ... 3. Ava Tolee ... 4. Dishholee ...	N. F. J. Troup.
14. Lodh ... ... (In Pergunnah Barramundul, Puttee Borake Rao)	Lodh	C. J. Ackland (lessee).
15. Lohooghat ... ... (In Pergunnah Kalee Kumaon, Puttee Bisong).	Lohooghat	Mrs. Richards.
16. Moosetee ... . (In Pergunnah Chandpoor, Putee Chuprakot, Zillah Gurhwal).	Moosetee	J. Henry.
17. Newton Dale ... ... (In Pergunnah Kalee Kumaon, Puttee Charal).	Newton Dale ...	J. Newton.
18. Nowghur ... ... (In Kutyoor).	Nowghur	Dr. Oldham.
19. Paoree .. .. (In Pergunnah Barah Syoon, Puttee Nandul Syoon, Zillah Gurhwal).	Paoree	J. Henry.
20. Ramgurh and Jhulna ... ... (1. In Pergunnah, Ramgurh, Kumaon) (2. In Puttee Occhoor)	Jhulna ... ... Ramghur	F. J. Wheeler. Capt. R. Wheeler.
21. Ryekote ... ... (In Pergunnah Kalee Kumaon, Puttee Charal)	Ryekote	W. J. Lyall.
22. Silkote ... ... (In Pergunnah Lohba, Zillah Gurhwal)	Silkote	Mrs. Cumberland.
23. Sitolee ... ... (In the suburbs of Almorah)	Sitolee	Capt. T. N. Harward and brother.
24. Tilwaree ... ... (In Pergunnah Budhan, Zillah Gurhwal)	Tilwaree	H. M. Shepherd.
25. Willow Bank... ... ... (In Pergunnah Lohba, Zillah Gurhwal.)	Willow Bank ...	J. Richards.

Mem.—Yield of Kumaon Tea, 1876: 578,000lbs. (370,000lbs. sold in India to Central Asian merchants.) Estimated yield, 1877, 690,000lbs.

TEA IN DEHRA DUN.

SKETCH OF ITS ORIGIN AND PROGRESS.

THE origin of the tea industry in the Dun dates back some forty years ago. Dr. Royle, then Superintendent of the Botanical Gardens at Shaharunpore, recommended the cultivation of tea in the Himalayas to the Indian Government in the year 1827, and again pressed the matter on the attention of Lord Bentinck during his visit to Shaharunpore in 1831. In his opinion, Jerrapani, situated about half-way between Rajpore and Mussoorie, at an elevation of about 5,000 feet, was the best site for the experiment. About 1834, Lord Bentinck, with the sanction of the Court of Directors, determined to give tea cultivation a fair trial, and the inevitable committee was appointed to draw up a plan for carrying out this design. Guided by the fact that, " in the mountainous tracts of our northern and eastern frontier, several species of plants are found indigenous which are also natives of China, and are not met with in other parts of the world, "plants raised from imported China seed were distributed to several of the Sub-Himalayan districts, and Dr. Falconer, Dr. Royle's successor, in May 1838, succeeded in growing tea plants in Shaharunpore itself, from seed procured from the nurseries at Koth, in Gurhwal. In 1844 a Government tea plantation was commenced at Kaulaghur in the Dun, a couple of miles west of the city of Dehra, under the management of Dr. Jameson; some 400 acres of land having been taken up for the purpose. The soil is described, in Williams's *Memoir of the Dun*, as " composed of clay and vegetable matter, with a slight mixture of sand, resting on the usual shingly subsoil of limestone, sandstone, clay slate, quartz, &c., found in the surrounding mountains." In 1850, Mr. Fortune a gentleman familiar with tea cultivation in China, was deputed by Government to visit the various plantations, and reported rather unfavourably on the condition of the plants at Kaulaghur, making various suggestions for the improvement of the cultivation. Again in 1856 the same gentleman reported much more favourably on the garden, attributing the improvement to his own suggestions. This elicited a reply from Dr. Jameson, pointing out that Mr. Fortune had previously condemned the Dun *in toto* as unfit for tea cultivation; and that any suggestions he had made had been anticipated by some notes on tea planting compiled by Dr. Jameson himself. The controversy attracted some attention at the time; but it is sufficient now to note that Mr. Fortune's condemnation of the Dun, as unsuited to tea, was evidently a mistake, as is, evinced by the yearly increasing outturn.

In 1857, Dr. Jameson estimated the tea-bearing capabilities of the Dun as follows:—

Number of acres capable of producing tea	...	...	100,000lbs.
Yield per acre	...	...	100 „
Total outturn	...	...	10,000,000 „

This appears to be a greatly exaggerated estimate as regards the area available for teas, while the estimated outturn per acre is far too small assuming anything like good management and cultivation. It will be seen from the tabular statements which will follow, that tea in the Dun, though unable, perhaps, to rival the large outturns in Assam and Cachar, which are known in some cases to be as much as 700 to 800lbs. per acre, is yet capable of producing at least four times as much as Dr. Jameson allowed; one garden of the Dehra Dun Tea Company showing an average for 1877 of more than 400lbs. per acre. On the other hand the area likely to be available for tea cultivation is considerably over-estimated. Including the southern face of the Mussoorie hills, from the watershed down, and the northern face of the Siwaliks, the total area of the district is about 450,000 acres. Of this, fully 250,000 acres must be deducted for forest reserves, the area of the stations of Mussoorie Rajpore, and Dehra, and for the numerous village sites. Of the remaining 200,000 acres, it is improbable that any of the area at present devoted to the cultivation of cereals and other food crops will be given up; nor would such soil be profitable for tea cultivation. Deducting this area, and allowing for the considerable amount of unprofitale land, such as the banks and beds of the broad stony "*sots*" or streams in which water flows only in the rains, it is improbable that more than 50,000 acres of land are practically available for the cultivation of tea. Taking into consideration the facts that tea gardens require a considerable amount of capital to start, and entail waiting several years for any profitable return, it would appear that 15,000 or 20,000 acres is about the largest admissible estimate of the area of land in Dun likely to be brought under tea, at least for a generation or so. Assuming that 20,000 acres may possibly be bearing tea in the course of time, and taking the outturn at 200lbs. per acre—a fair average of the present production in the Dun on the working gardens—a total yield of some four millions of pounds, or less than half of Dr. Jameson's estimate, may be looked for in the dim and distant future; but such a prospect is too remote to be of any practical value. The present outturn, although it has more than doubled in the last five or six years, is only a little over six lakhs of pounds, or about one-seventh of the possible production estimated above.

Several other tea gardens were opened out in the Dun within the decade succeeding the commencement of the Government plantation at Kaulaghur; and by the year 1862, about the same time as the elder Williamson was planting out garden after garden in Assam, and several tea companies had been formed there, the present Dehra Dun Tea

Company, comprising Hurbunswala (formerly the North-West Tea Company's garden) and Arcadia, both then garden several years old was started. It was originally under the same Calcutta direction as the now defunct Central Assam Company, whose gardens are still flourishing under the management of the Land Mortgage Bank. This Dehra Dun Company has passed through many vicissitudes and changes of management, and at one time it came near to share the fate of the Central Assam Company, its shares being quoted at a discount of 97 per cent. But it pulled through somehow; and now, with a local board off direction, and two thoroughly practical and experienced planters as managers, its gardens are undoubtedly the best in the Dun, as the tabular statement (II) clearly shows.

In 1867 the Kulaghur plantation was sold by Government to the Raja of Sirmoor for two lakhs of rupees, and it has now developed into a valuable property, which well repays the purchaser, giving him a gross yearly income of over half a lakh of rupees, excluding working expenses. In 1862, Dr. Jameson estimated the area under tea at 2,500 acres, and in 1864 it was put down in Mr. Daniell's settlement report at about 1,700 acres; but these figures are in neither case very reliable.

Present Area and Outturn.

In 1872 the Government called for returns regarding the area and outturn of tea in the Dun, but the figures arrived at by them differ considerably from the results obtained by Mr. Williams, the Assistant Superintendent of the Dun, in 1871, who, at the request of the Secretary of the Board of Revenue, N. W. Provinces, made careful personal enquiry into the matter. The figures accepted by the Government were as follows:—Area, 1,801 acres. Outturn, 411,548lbs. Average per acre, 228·5lbs.; while Williams gives a larger area, but a much smaller produce, *viz.*:—Area, 2,024 acres Outturn, 287,828lbs. Average per acre, 142lbs. The latter figures are probably the nearer approach to the truth; although, as will be seen from Mr. Williams's return, which is appended, the outturn is not in all cases for the same year; in some places the produce for 1870 being given, and in others that for 1871. Moreover, in most cases the figures are only estimated, the exact actual outturn being given for only one or two gardens.

However, this statement being the result of personal enquiry, and agreeing so closely in total, if not in detail, with the area of old tea given in statement (II.) for 1877, it is probably correct as to area, and not far out as to outturn; though the average per acre is much smaller than that arrived at by the Government return, and also than the present average. Mr. Williams seems to have been impressed by Dr. Jameson's estimate of 100lbs. per acre, which was, as has been shown, far too small.

(I.) Abstract of Mr. Williams's Return of Tea in the Dun in 1870-71.

Name of Plantation.	Area in Acres.	Outturn in lbs.	Remarks.
Dehra Dun Co. ...	550	130,000	For 1871.
Annefield ...	300	50,000	
Banjarawala ...	100	5,264	For 1870, approximate figures only.
Lakhanwala ...	50	1,048	Do. do.
Kaulaghur ...	250	54,026	Exact outturn.
Goodrich Gardens...	82	6,240	For 1871.
West Hope Town ...	68	10,000	
Naranjanpur ...	80	4,800	For 1870. Irrigated by canal.
Ambarree ...	170	13,000	For 1870.
Rose Villa (or Hurawala ...	48	3,000	
Charleville ...	76	4,000	Under native management. Approximate figures for 1870
Harbajwala ...	110	9,000	Under native management.
Garhi	30	2,200	Do. do.
Dartawala and Ambiwala ...	17	800	Do. do.
Nathanpur ...	15	450	Do. do.
Doom Singh's Garden	59	3,000	Do. do.
Kanya Loll's Garden	19	1,000	Do. do.
Acres ...	2,024	297,828	

(II.) Statement of Area under Tea, and Outturn for 1877.

Name of Plantation.	Area under Tea.			Total Area.	Outturn in lbs.	
	Old Tea.	Young Tea.	New Tea not bearing.			
Ambari	170	......	30	200	37,500	
Annefield	285	30	......	315	100,000	*
Jiwangarh and Rambagh	40	100	50	190	10,000	
W. Hope Town Co....	80	160	......	240	25,000	*
Lakhanwala	35	......	......	35	6,000	*a
Goodrich Gardens	107	206	......	313	40,000	*
Hurawala	60	......	......	60	10,000	*
Arcadia	261	18	......	279	103,680	b
Harbanswala	318	......	56	374	139,750	b
E. Hope Town	......	4	90	94	1,000	b
Naranjanpur	125	......	40	165	25,000	*
Kanya Lall's	20	......	......	20	2,100	a
Harbajwala	75	......	......	75	12,000	*a
Doom Sing's	50	......	......	50	7,500	*a
Ramnath's	45	......	......	45	6,500	*a
Kaulaghur	300	... ..	30	330	70,000	c
Mulakawala	45	......	......	45	7,800	c
Banjarawala	71	......	......	71	18,530	
Nathanpur	25	......	......	25	2,000	a
Total ...	2,112	518	296	2,925	624,360	

* These quantities are approximations only, but are close to the exact figures. For all other gardens the actual outturn for 1877 is given.

Remarks.—(*a*) Native management; (*b*) Dehra Dun Tea Co.; (*c*) Rajah of Sirmoor's Gardens.

The above tabulated statement (II.) shows that the area bearing tea in 1877 was 2,630 acres, and the total produce was 624,360lbs. giving an average over all of 233lbs. per acre. It will be noted, however, that in the 2,630 acres are included 518 acres of young tea, mostly only four or five years old, which is of course only very lightly plucked, and therefore contributes to the average outturn only to lower it. It would have been more accurate to have separated the produce of the young tea from the old, and thus have obtained a better idea of the average outturn of tea in full bearing in the Dun; but for obvious reason this was impracticable.

But the foregoing statement does not exhibit all the land under tea. During the last two years tea enterprise has made rapid strides; several new gardens have been commenced, and a considerable area has been, and is still being, brought under cultivation. The following statement shows, in addition to the 296 acres of new tea on the old plantations, the area under plant in the gardens, also the estimated extensions both on these and on some of the old plantations. In addition to the items noted in statement (II.), it is probable that there may be other extensions, both in existence and in contemplation, as it is more difficult to obtain reliable statistics on this point than on any other. Moreover, it is impossible to say what new enterprises may not be started within the next year or two, now that the Eastern Dun is being opened out. All the new gardens are in the Eastern Dun. One of them, Dhoiwala, formerly had a considerable area under young tea, but it was rooted out and destroyed, or allowed to die out, to give place to the cultivation of rhea grass—a speculation which, unfortunately, resulted in failure; and the new proprietors of the grant are now reverting to tea again.

(III.) Statement of Extension and New Gardens, 1877-78.

Name of Garden.	Area under plant.	Estimate extension within a year or two.	Remarks.
Goodrich Gardens	......	500	Seed beds planted out for this area. } Old Gardens.
E. Hope Town	......	100	} Old Gardens.
Balawala	10	50	
No. 8 Grant	15	185	
Chapori	70	50	
Gorakhpur	21	71	
Kuanwala	14	186	
Dho'wala	25	75	
Sundry small Gardens	80	......	Mostly small patches of tea in and about Dehra itself.
Area brought forward	296	......	From Statement II.
Total ...	531	1,217	

The total area of land at present under tea in the Dun is therefore about 3,160 acres; and there is little doubt that within the next two or three years it will amount to fully 5,000 acres, as extensions which will bring it up to 4,378 acres are already in contemplation; while it is probable that new ventures may be opened out ere long. Assuming Mr. Williams's figures for 1870-71 to be correct, the area of tea cultivation in the Dun has increased by more than a thousand acres during the last five or six years, while the tea produced has more than doubled itself during the same period.

The average outturn per acre of seven of the different gardens is given below, only those gardens being selected whose area and produce as given in statement (II.), is known to be absolutely correct.

			lbs	
1.	Hurbanswala	...	440	Dehra Doon Co.
2.	Arcadia	...	397	Dehra Doon Co.
3.	Bengarawala	...	260	Private.
4.	Kaulaghur	...	233	Rajah of Sirmoor.
5.	Ambaki	...	220	Private Company.
6.	Mulakawala	...	173	Native management.
7.	Nathanpur	...	80	Do. do.

The Dehra Dun Tea Co., *facilis princeps*, heads the least, completely distancing all competitors. This is mainly owing to careful cultivation and manuring, an admirable system of pruning, and to the absence of all irrigation from the canals; which irrigation, owing to the large quantity of lime held in solution in the water, is now almost universally acknowledged to be eminently injurious. In Hurbanswala, in particular, which, after Kaulaghur, is one of the oldest gardens in the Dun, the bushes are as fine as can be seen in any part of India, and totally different from the stunted and miserable specimens to be seen in many of the smaller gardens.

CULTIVATION, MANUFACTURE, LABOUR, AND GENERAL REMARKS.

THERE appear to be certain differences of opinion on several points connected with the cultivation of tea, as regards the best method of sowing nurseries, transplanting, pruning and as to whether irrigation is or is not beneficial. A few nurseries have been sown under the artificial shade of grass *tatties*, which are placed over the young seedlings whenever the sun is at all powerful. The general opinion is decidedly against this practice, as tending to make the seedlings delicate and sickly; most planters put out their seedlings in the open, and without any artificial irrigation. One experienced planter says:—"Our seed-beds are not irrigated at all, and are not put out under the shade of trees, for they are found to do best when in the open plain. Even in 1877, the driest year known in the Dun for 100 years, the seedlings grew well without water in the open plain." Transplanting from nurseries to fill up vacancies and to plant out extensions, is generally carried out during the rains, a considerable quantity of moisture in the soil being needed to cause the young plant to take kindly to its new locality; while the general opinion seems to be against artificial irrigation, in this as in all other cases. Artificial irrigation, particularly from the canals, seems to be almost universally condemned, as not only of no benefit but as absolutely injurious, and in many cases fatal to the tea plants, whether young or old. In the Hurbanswala garden, patches of vacancies occur which it seems impossible to fill up. The ground has been well manured, and seedlings have been planted out in these vacancies, and tended most carefully, but they never thrive, and eventually die out again. These sterile patches invariably exist on the banks of old *kuls* or minor irrigation channels, leading from the canal; and the manager of the Hurbanswala garden, one of the best and most experienced planters in the Dun, is of opinion that the unconquerable sterility of these patches is due to the former thorough saturation of the soil with canal water. The destructive effect of this water is attributed to the enormous quantities of lime held in solution by it. The hills north of Dehra being generally of limestone formation, and some of the streams which feed the canal being so strongly impregnated with lime, that it is impossible to boil pulse in their waters, a few drops of which will curdle milk, it may readily be conceded that these waters are not likely to have a beneficial and fertilizing effect. On the suject of irrigation, the planter before quoted writes:—"The Goodrich plantations were once under irrigation, and there were 45,000 vacancies. Of these, some 30.000 have been recovered by giving up irrigation; and by careful hoeing vacancies have spontaneously filled themselves up after a disappearance for three years. .... Wherever the canal water has been run into the tea, the plants have died out, chilled by the water."

Canal irrigation being so injurious, and well irrigation, from the nature of the locality, being practically out of the question, it follows that the planter must depend entirely upon the rainfall. When this is up to the average and fairly distributed over the season, without any long intervening space of dry scorching weather, a first class outturn may be anticipated. Even if the rainfall be considerably below the average, and yet the showers recur at comparatively short intervals, a good outturn may be expected. Last year, 1877, the rainfall was very scanty, but what little there was, was well distributed over the season; so that with careful cultivation and good management, several of the gardens turned out the largest average outturn per acre they had ever done, Hurbanswala giving 44lbs. per acre. In 1873 the total amount of rain was rather above than below the average, but the rains were very late in setting in, very heavy when they did come, and the preliminary hot weather very severe, the result being a very poor outturn

of tea, the abovenamed garden giving only 190lbs. per acre.

The number of "flushes" of leaf in the year is naturally an uncertain quantity; some consider that there are only three or four distinct flushes, but such flushes stand more than one plucking. In Assam, a flush every ten days or a fortnight, in the height of the season, is no unusual thing, necessitating a considerable increase in the temporary labour devoted to plucking, to get round the garden before the flush gets hard or *banji*; and in a very good year in the Dun, somewhat similar flushes, though less rapid in their re-appearance, keep the manufacture going on almost uninterruptedly from April till October. But in an average year, there is a distinct break between April and June, of duration varying with the date of the setting in of the rains, in which no leaf is available for plucking. As a rule, plucking commences towards the end of March, and the first flush is exhausted and the "spring crop" gathered in by the middle of April. This year most of the gardens had commenced manufacturing, and made several thousand pounds of tea before the end of March. Plucking begins again in June-July, according to the setting in of the regular rains, and continues, with an occasional break varying in date and duration according to the rainfall, until the end of October or beginning of November. The average number of plucking days throughout the year is about 120.

Pruning is carried on at various times, the "tipping" of the upper shoots being generally done as soon as the sap has fairly descended, about December and January. Advantage is taken of the break after the spring crop is got in to clean out the bushes by cutting out dry and heavy wood from them, so as to give room and air to the greener and more prolific branches. Various opinions obtain as to the best methods of pruning; the most generally received and successful has been indicated.

The Dehra Dun Tea Company and some of the other gardens also go in steadily for manuring, making it a rule to get round the whole garden at least once in three years. Ordinary cattle manure is generally procurable from surrounding villages at about 10 or 12 cart-loads per rupee, and from its beneficial effects, seems to contain all that is necessary to restore to the soil such fertilizing elements as are taken from it by the tea plant.

The labour question, so complicated in Assam and other tea-growing countries, dependent on imported labour, is here a simple matter. As a rule, local labour is obtainable in any quantity, though the labour-market varies to a certain extent inversely with the grain market, coolies being more readily procurable in a year when high prices prevail than in a year of plenty. The average wages are Rs. 4-8 per mensem to beldars, and Rs. 5 to tea makers; leaf plucking being paid for by contract rates at so much per seer, the fluctuating demand for this class of labour being supplied by the women and children of neighbouring villages. Imported labour, or coolies, serving under agreement or contract for a fixed period, are unknown and unneeded in the Dun.

The manufacture is, of course, much the same process as elsewhere. Little or no machinery is used, the rolling being done entirely by hand, and the panning and drying off in the usual manner. The Dehra Dun Company have lately got up from Roorkee a new cylindrical revolving drying machine, the tea being enclosed in wire cages within this long cylinder, and kept revolving, while blasts of hot air are driven through; but the machine has not yet been practically tested.

A good deal of green tea used to be manufactured and sold locally to Cabulee and other trans-frontier merchants, who came to the factories and took over the tea in bulk, packing it into their own bags, and casting it off at their own expense. This was a very profitable method of disposing of the produce of the gardens, as packing and freight charges were saved, but from various causes, partly political and partly local, carelessness, and competition elsewhere, this demand gradually declined, and has now ceased altogether. Very little green tea is now made in the Dun, probably not more than 15,000lbs; and the bulk of the outturn of all classes of tea is packed and transmitted to Calcutta, either for sale there or for shipment to England. A small quantity of tea is offered for sale occasionally at the general auctions in Mussoorie, and some comparatively large parcels are bought up by a local firm, Messrs. Buckle and Company, for retail sale; but as compared with the total outturn of over six lakhs of pounds, the local sale, since the loss of the Cabul and trans-frontier custom, is comparatively small.

The class of plant in the Dun is principally China and hybrid, with a close assimilation to China. Of Assam hybrid there is very little, and of the pure Assam variety but one or two isolated specimens. The Assam and Assam hybrid are both far too delicate plants to withstand the hard climate and winter frosts of the Dun; and there can be little doubt that the larger and softer leaved varieties of the tea plant are unsuited to the Dun, while the hardier China and China hybrid, though less productive in softer and milder climates, are best suited to the northern sub-Himalayan tracts. As regards quality, the Dun teas, like most Himalayan teas, are, as a rule, superior in delicacy of aroma and flavour to those of Assam and Cachar, though inferior in strength; and may be classed with the Kumaon and Kangra Valley teas.—*Pioneer*.

APPENDIX XV. TO MR. G. R. C. WILLIAMS' HISTORICAL AND STATISTICAL MEMOIR OF DEHRA DOON, 1874.

List of Tea Plantations in 1871.

No.	Name of Plantation.	Name of Owner, &c.	Estimated Area under Cultivation in Acres.		Estimated Annual Outturn in lbs.	Estimated Value of Annual Outturn.	Remarks.
			Acs.	Rds.	lbs.	Rs.	
1	Arcadia ...	Dehra Doon Tea Co., Limited.	220	0	50,000	70,000	This calculation is for 1871. Manager says that allowing the possible outturn to be 15,000lbs., and making deduction for loss, he considers 125,000lbs. only as the amount which would actually reach the market. He has also made allowance for the fact that the class of tea made by him (green) has fallen 3 annas and 4 annas a lb. since February.
2	Hurbunswala ...	Manager, Mr. Minto ...	330	0	80,000		
3	Ann Field Tea Company.	Manager, Mr. Watson	800	0	50,000	37,500	
4	Bunjarawala ...	Mrs. Knyvett ...	100	0	5,264	2,632	This calculation is for 1870. The concern being a private one, and badly managed, like all of the same sort on the Doon, it is hard to obtain exact statistics, but those given are pretty correct.
5	Luckunwala ...	Ditto	50	0	1,048	655	Same remarks apply here also. Moreover, this was a jungle in 1869, and not more than 400lbs. of tea have been sold as yet.
6	Kowlaghir ...	The Nahun Raja ... Manager, Mr. Mooney	250	0	54,026	27,013	
7	Goodrich ...	Mrs. Vansittart ...	80	0	6,200	3,900	The outturn in 1869 was 400lbs.; in 1870, 5,000lbs. That given is the estimated outturn for the current year. The value of the 1869 outturn was 2,000 rupees, which in 1870 increased to 3,300 rupees. Mrs. Vansittart considers that this may possibly rise to 4,000 rupees in 1871
8	New Goodrich ...	Ditto	2	1	40	28	A very young plantation, tried experimentally in other soil.
9	West Hopetown Company, Limited	......	68	0	10,000	6,250	The Company has been kept going by contributions among the shareholders, but its prospects are improving. Col. Macpherson, the resident shareholder to whom the accounts are rendered, has furnished this return.
10	Nirunjunpoor ...	Col. Macpherson ...	80	0	4,800	3,000	This calculation is for 1870. The plantation in that year did not pay its working expenses, in spite of facilities for canal irrigation.
11	Ambaree ...	Ambaree Tea Co. ... Manager, Mr. Barnard	170	0	13,000	10,000	This calculation is also for 1870.
12	Rosevilla ...	Capt. Swetenham ...	48	0	3,000	2,000	
		Carried over ...	2,198	1	277,378	1,62,978	

No.	Name of Plantation.	Name of Owner, &c.	Estimated Area under Cultivation in Acres.		Estimated Annual Outturn in lbs.	Estimated Value of Annual Outturn.	Remarks.
			Acs.	Rds.	lbs.	Rs.	
		Brought forward ...	2,198	1	277,378	1,62,978	
13	Charleville ...	Mrs. Dick, let to Mrs. Reilly.	76	0	4,000	2,500	The returns for 1869 when the estate was in Mrs. Dick's hands, are as follows:— Acres. lbs. Rupees. 60 3,000 1,800. In 1870, the estate was under the management of a native agent, who is said to have rendered no account. The calculation for the present year is a rough estimate by Mrs. Reilly's son.
14	Hurbhujwala ...	Lala Ram Nath ...	110	0	9,000	5,344	
15	Gurhee ...	Ditto ...	30	0	2,200	1,362	
16	Durtawala and Ambeewala.	Mohunt Pretum Dagh	17	0	800	300	
17	Nuthunpoor ...	Myan Rubere Sing, son of Raja Lall Sing.	15	1	450	281	
18	Dhoom Singh's Plantation.	Dhoom Sing ...	59	0	3,000	1,500	
19	Nirunjunpoor ...	Kunhya Lall ...	19	0	1,000	600	
		Total ...	2,524	2	297,828	1,74,865	

Tea in Dehra Doon.

The Dehra Doon Tea Industry has increased with surprising rapidity during the last ten years. For some few years now, the Doon planters, as also those of Kumaon and the Kangra Valley, have had to face circumstances running against them. These untoward circumstances have dated from our occupation of Quetta, which rendered Ameer Shere Ali suspicious, and the consequence was the closing of the Central Asian Market. Orders had previously come from the holy city of Bokhara, and buyers came to the doors of the planters, gave them good prices, and took the tea away in bags. The initiation of a new policy under Lord Ripon has revised the Central Asian tea trade, which indicates a confidence in our being able to keep communications open. It would be hardly fair to expect high prices all at once; but news from Umritsur raises the hopes of the planters. Indeed, since I commenced these letters, the Umritsur tea merchants have been buying liberally. The good done by tea cultivation in the Doon can scarcely be estimated. A few years ago they were losing heart and desponding, but better times appear to be coming. I may mention, as an illustration of the hopefulness of men who have taken to tea culture, that on a plantation which I visited on my way out to Nahun, I could look over 1,000 acres; a good share of it planted since a former visit six years ago. The pioneers of tea cultivation had a hard time of it. In 1848 nearly 54,000 acres of cultivable land were lying in waste. A few grants have been made ten years before to favored individuals, many of them Government officials, but failure resulted from numerous causes, such as unwieldy grants, deaths of cultivators from malaria, ignorance of the grantees, and hopes of great things from Government. But, alas! Government officials were prohibited holding land by the Home Government, and there was a panic, many civilians selling their interests for almost anything offered. Immediately after that, however, the rules were relaxed, and even civilians have cultivated the Doon resources to a profit. The grants, too, under Lord Canning's rules, helped European enterprise by allowing the purchase of estates in fee-simple.—*Indian Daily News.*

Dehra Dun Grants.

There are in round numbers about 500,000 acres of land in the Doon, and of this large expanse it may safely be said that more than one-half is suitable for tea. Of this 250,000 acres, the total area under tea, is not over 2,500, or 1 per cent., and yet we read that tea land in the Doon is scarce "and dear." These two statements seem irreconcilable, yet they are both true. The fact is, that almost all the suitable land here is reserved by Government, and is under Forest control.

The natives call the Forest Officers the "Junglee-wallah Sahibs," and a more suitable appellation could scarcely be found; not that it applies to them personally (as doubtless they are gentlemen) but to their office; for they have not charge of forests, but jungles. In no other country in the world, save India, would these preserves be styled Forests.

If you go into one of these preserves you find something that might have posed for the late Canon Kingsley's description of West Indian tropical vegetation—knarled trunks of trees that will never be of any use except as firewood; every third tree warped and barkbound by jungle creepers; and an undergrowth of suitable density for harbouring wild game. The highly-paid officers are busily employed in granting passes to any one who chooses to purchase firewood at 10 annas per cart load, or grass at, I am ashamed to say, how very small a number of annas per load.

Now and again we read in the *North-Western Provinces Gazette* of so many more square miles being reserved under 2nd Section of Act VII of 1865: which simply means so many miles removed from the operation of the planters to be cultivated as jungle. In the *North-Western Provinces Gazette* of 17th March 1877, p. 285, the details are given of a large tract of land being reserved for State Forest—the quantity being 561·54 square miles. This is equal to 359,385 acres, a large proportion of which is suitable for tea. Almost all the available land is in the hands of Bunias and small zemindars, who, as a natural consequence, get abnormally high prices for their land when they deign to sell; but their ideas of the value of land for tea are so inflated that many of them wont sell at all. Would it not be wise were Government to give grants of this fine land to *boná-fide* investors in tea? Capital would speedily flow to the district, and this, absolutely the healthiest corner of India, would soon become a vast smiling garden.

The climate is peculiarly healthy for European and Native alike, and labour is abundantly procurable at Rs. 4-8 per month. Notwithstanding coolness of the climate, gardens well managed here give an outturn of 300lbs per acre, and some of them are on the fair way to give 400lbs this year. Some couple of years ago Government offered to give grants for intending planters; but, as usual, the conditions were such that no land was taken up. One condition was, that the ownership of the growing timber rested in the Forest Department, who might cut and remove it at any time. This alone would put a stop to all enquiries for land. Now that we are promised a light railway through the Doon, the time is all the more propitious for opening out the country, and I hope the Government will see its way to give grants without any absurd conditions attached to the pottahs. By all means make it a *sine quá non* that the land shall only be taken up for tea or coffee, as the case may be, and that it can and will be resumed by Government if it be used for other purposes, or if a steady improvement of the grant is not carried on.

For the proper carrying out of these views, it would be well not to make larger grants than from 200 to 500 acres to private individuals, and double that quantity to companies with sufficient capital to make a proper use of the property—as in former times large grants in Cachar and Assam were taken up for purely speculative purposes. I have no doubt that were proper care exercised in bestowing these grants, great good would be the result.

With the view to carrying out the proposed grants properly, I would suggest something like the following arrangement:—

That grants consist of, say, 500 acres each.

That all rights other than mineral should go to the grantee, with the proviso that the collector, should he find that the grantee is recklessly cutting the timber without proportionally improving the grant, should have power to stay proceedings with a view to the grant being ultimately resumed should his suspicions be correct.

That the grantee be compelled to open out a certain percentage of the land within fixed periods; otherwise the grant to be resumed by Government...

This was in force in Cachar and Assam 15 years ago, but the proportion to be opened out was fixed at too high a rate: hence the grantee in most cases failed, and unpleasant friction between the Government and the holder was the natural result. I would suggest that a minimum of 20 per cent. per annum ought to be fixed,—this to be opened out in tea; or when funds for that purpose might be short, a double quantity to be opened out, by means of ryots, in grain; so that each year either 10 acres of tea or 20 acres of grain would be the minimum rate of extension. This to continue till, say, 60 per cent. of the grant was under cultivation. This plan would soon make the Doon a smiling garden.

From time to time the Government officials here stop payment of Government Currency Notes at the Treasury on account of a paucity of silver. This again is of course due to light collection of revenue, and this while lacs of fine land are under jungle, which may or may not be of any value to our great-grand children.

Were 200 of these grants taken up on the above conditions, the results would be an annual increase of land brought under cultivation of about 2,000 acres, and an annual increase in production of tea of about 5 lacs of lbs., with an annual increase of capital spent in the district of Rs. 2,00,000. Besides, there would be the steadily increasing value of land for land-revenue purposes. It may be urged that labour could not be had. This is a mistake. The number of labourers that would be required for these extensions would be 1,500 each year, and that could be no sensible drain on Rohilcund, whence our plentiful supply comes.

The Doon is peculiarly suitable for trying this experiment, for the following reasons:—

1*st*.—The district is eminently healthy, and living is cheap.

2*nd*.—Labour is plentiful and cheap; for instance boys, women and girls:—

For leaf plucking, manuring and other light work	...	Rs. 1-8 to Rs. 3
Field hands	...	4-8
Tea makers	...	5

3*rd*.—Tea can be turned out here for 4 annas per lb. including all charges, where a sensible man is his own manager and really looks after his work.

For these reasons I would urge on Government the advisability of opening out a lac of acres, and handing the same over to grantees on some such terms as I have proposed. This, as an experiment which I feel assured would be successful, would result in bringing a healthy and certain living to thousands of poor natives now dragging out their existence at their homes, besides affording scope for European capital and enterprise, and benefiting the Government Treasury receipts in no small degree.

TEA AT THE ANDAMANS:

Being Notes of a Visit, by the Editor, to the Experimental Government Tea Estate of Port Blair.

OUR readers may recollect noticing some time back the mention in these columns of the fact that tea planting was being tried at the Andamans. During the recent Poojah holidays we took the opportunity of a sea trip to Port Blair to pay a visit to "Aberdeen,"—the island of the Andaman group upon which tea-growing has been commenced; and where also other growths are being experimented with. The land is slightly undulating, and rises only some 200 feet from the sea level. The soil is good loamy clay with sandstone, and the subsoil is of a character to afford excellent drainage. The general lay of the land, also, is favorable to natural surface drainage. The bushes, which are mostly Assam (rather mixed) hybrids, are planted about 5 ft. 4 ft. × 6 in., and at present are nigh four years old. They are of good height, and now require to spread. The general appearance is of the healthiest character; the wood is clean, and the leaves as fresh and glossy as could be desired, while there is now a flush on which would make many a hill planter's mouth water; and there is an entire absence of blight of any kind.

The land is kept thoroughly well hoed, the earth is packed well up round the roots of the bushes, and the whole plot of land where the tea is growing is as clean as the beds on a well-cultivated flower garden; and yet from what we gathered the labour force up to date has been small, but then it has been well directed and controlled. Unfortunately, the flush, which we have referred to as being now on the

bushes, will be lost, because the factory is not yet complete. It seems strange that the P. W. Department should have allowed such a thing to happen, for, as we understood on the spot, it was not for want of due representation of the necessity for the earlier erection of the factory that the delay has occurred. However, a few months will see a very serviceable building completed, and it would be well if the authorities were at once to arrange for a competent tea maker to take charge, and give the experiment a fair chance; for it is no use growing good leaf if it is to be spoilt in the manufacture; and, although the extent of land at present under cultivation is small, an assistant would find ample occupation in clearing, cultivating, and extending in addition to his supervision of the factory. The officer in charge at present is Lieutant-Colonel Berkeley, who himself possessing a tea plantation in the Nilgiris is, besides, a good botanist and an experienced planter; but his duties at Port Blair, as Chief Commissariat Officer, are so multifarious and onerous, that although he takes the warmest personal interest in this experimental tea garden which does him so much credit, and although he has been thoroughly successful in its development, yet he cannot necessarily devote that regular and close supervision which is necessary,—more especially so now that the bushes are arriving at maturity, and that constant manufacture will soon be required; for after March next, when the dry weather ceases, the flushes may be looked for in plenty, the climate giving for 8 months of the year that moist warmth which the tea plant luxuriates in, and thrives so well under. In fact, the climate may be compared to that of favorably situated Indian terai land, with this difference, of course, that there is always more or less of refreshing breeze from the sea; and, as the places where cultivation has been begun in earnest have been well cleared of trees and jungle, there is little or no fever.

It would, we think, be a matter for much regret if the Government should allow an experiment thus auspiciously commenced to fail of practical good for want of due continuous professional supervision, and we trust to hear soon that it has been resolved to provide Lieutenent-Colonel Berkeley with a competent assistant, able to carry out his orders, and to see to the minutiæ of the factory and the garden. There are only too many planters just now out of employment, whose services could be secured at a very moderate salary; for living, at the Andamans, is cheap, and it is almost impossible to spend much money there,—all supplies being furnished through the Commissariat. As to isolation, in this respect a man would be not so badly off as in many parts of Assam. There are several European Superintendent employées on the Islands, besides of course the settlement officials; and as each departmental head appears to be provided with a boat and convict crew which remains at his command, it is a matter of only an hour or less to communicate with the different islands of the settlement. (*En passant*, we may mention that anything more charming than a row or a sail on the clear blue sea inlets among the group of islands can hardly be imagined).

In speaking of tea cultivation at the Andamans the question not unnaturally arises whether it is a desirable thing for Government to step in as cultivators to the possible injury of private enterprise elsewhere,—it being notorious that the supply of Indian tea is already greatly in excess of the demand. Well, on this point we can only say that, if we thought there was any intention of carrying the matter beyond the phase of a sufficiently large experiment with a view to demonstrate the practicability of successfully cultivating tea on the island, we should be the first to condemn it; but as we take it, if ever cultivation on any large scale be attempted, the whole affair will be made over to private hands. At present there seems to be considerable objection on the part of Government to permitting the advent of free settlers, or non-official capitalists, from outside. One reason for this is, perhaps, that as all the labour on the Settlement has to be performed by convicts, and as the number of these (though amounting to some 12,000) is not sufficient for present requirements, it would be impracticable to afford colonists the necessary assistance of labour or protection of life. And if, again, coolies were brought from India, in any quantity, the civil administration would have to be strengthened. No doubt it will follow, as a larger number of ticket-of-leave-men are accumulated on the islands, that many of the present disabilities surrounding free immigration will be removed, and we fully believe that a few years hence the population will be largely increased from within. Convicts who have served ten years with good conduct are allowed to marry, and numbers now are scattered about the settlement as free labourers on their own account; and it appears that they are, as a rule, thorough-

ly well behaved, and so well off that few wish to return to their native land even had they the chance.

The Government, besides experimenting with tea, has tried coffee, but the climate seems unfavorable to the plant, as just at the time of year when rain is most wanted for coffee, there is least rain at the Andamans. Sugarcane, however, bids fair to be a great success, and cocoanut planting has proved highly profitable. In fact almost anything will grow well there, and the grass is so luxuriant that hay to almost any extent might be manufactured. All these things of course would pay better if there were a sufficient local demand to absorb the yield of various kinds which the islands are capable of affording; and that is why we venture to express the opinion that Government would do wisely, as soon as it feels it can safely do so, to encourage settlement from outside. There are many men in India on pensions which permit them only close economy here, who would be able to live at the Andamans far more comfortably, could they take a small quantity of imported labour with them. Thus, cultivation would increase, farms would spring up, additional land would gradually be cleared, and a free population would in time accrue, affording protection rather than the reverse to the Settlement.

Tea in Aracan.

There seems to be a good field for tea cultivation in the province of Aracan. The only area at present under cultivation consists of some 100 acres, the production of which is stated as between 20,000 and 30,000lbs. annually. The price realized in London last year was from one to three shillings per lb., while in Rangoon it appears impossible to buy Aracan tea under 2 rupees a lb. The Burmese are inveterate tea drinkers, and there is apparently no limit to the demand which could be created were Aracan tea sold locally at a much more reasonable price; which would clearly be practicable, with still a large margin of profit. What is wanted is extended cultivation.

New Notes on District Tea Cultivation.

By the Editor.

There is perhaps no district in which tea cultivation has been more rapid in growth than Chittagong. It may almost be said, indeed, to have become now a special industry of the place, and there has been an almost entire absence of the labour difficulty. We think we shall not be far out in estimating that there are now some 2,500 acres in the Chittagong, Noakally, and Chittagong hill districts, under tea, and extensions are still taking place. There are several native proprietors, but mostly on a small scale. Chittagong tea has not hitherto realized good prices in London, or even in this market: it is reported as deficient in point and flavour. This may, however, be overcome by greater care in manufacture, as the soil and climate of the district is all that can be desired for tea.

Tea in the Terai and the Western Doars.

The writer recollects, well, passing through the Darjeeling Terai some seventeen years ago, and feeling excessively anxious not to be found travelling along the broad road (leading to Punkabaree) surrounded by dense brushwood and jungle which spoke of wild animals and deadly malaria. He has within the last few years, and recently within the last few months, been again several times along the same route, and where jungle and dense brushwood was then, now on either side are seen miles of cleared land, with tea gardens of no inconsiderable size before the eye. It must not be supposed, however, that this clearance and new cultivation has been effected without risk. Many lives have been lost, and even to this day the Terai, to some, is almost a certain grave. Given a strong constitution, temperate habits, and moderate diet, a man may get along, in the Terai, fairly well, as to health,—with perhaps only an occasional touch of fever; but if he recklessly exposes himself to the sun, remains in damp clothes, or overdoes his "beer" or "peg," he is likely to have a hard time of it. A well-known authority has remarked that this Terai climate, with its moist heat, which is so exhausting to the human frame, is the best of all climates for the tea plant; and that this is so there can be no doubt. You must have moisture with the heat to produce frequent and strong flushes; and we find that, as regards yield, the lower slopes bordering near on the Balasun, the Teesta, and other rivers in the Darjeeling district, (where fever in the case of Europeans is almost chronic, if they remain there) give by far the best yield and the strongest class of tea. As a rule, a planter having cultivation extending downwards several

thousand feet, nevertheless has his bungalow at the highest possible elevation; but it is inevitable that, almost daily, in the performance of his duties, he has to descend from say, an elevation of 4,000 or 5,000 feet, to a level of 1,200 or 1,500 feet. This cannot but prove most trying to the constitution, and such is found to be the case. Of course, in the TERAI, the climate is equal, and if a man be careful, he may pull through, even though he cannot sleep, like his brother planter in the hills, at an elevation of some 5,000 feet.

Speaking of "yield," in the TERAI it is necessarily far in advance of that of the upper hill districts, and the quality and outturn assimilates nearest to the best Assam locations. A theory has been started, however, that the depth of soil is slight, and that in a few years, owing to the action of the inundations caused by heavy rains, and too frequent hoeing, the subsoil will become exposed, and the bushes cease to derive sufficient nourishment for their lateral roots. We do not believe this assumption to be based on the facts or probabilities of the case. It may be necessary to pay increased attention to deep drainage, so as to allow the surplus water from the hills to find its way more speedily to the rivers—the natural outlet—and also to pay every regard to as thorough surface drainage as possible. But if, as we believe is the case, there is 10 feet of good soil in most parts of the TERAI, there can be little fear of the difficulties hinted at occurring.

UNDER the heading "Tea Yield," in another section of this WORK, will be found particulars of the yield of various districts; and notably, it will be seen, that of estates, on the DOARS. These are the latest lands which have been settled, and very encouraging, as regards tea culture they seem to be. Colonel Money considers them to promise the highest of all yields. The climatic conditions are much the same as those in the Darjeeling Terai, in comparison with which they have been much less opened up; but should the demand for Indian tea increase at home, as we have reason to believe will be the case, there is little doubt that the WESTERN DOARS will be the seat of a largely extended tea cultivation before many years.

TEA IN CHOTA NAGPORE.

ONE great advantage which this district possesses is the abundance and low cost of labour, and tea can be laid down in Calcutta, from Parisnath, Lohardugga, and Hazareebagh, at rates which would secure large profits to Assam and Cachar districts could they do the like. But as against this reduction of cost, steps in an inferiority in quality, and diminution in yield; and planters in the Chota Nagpore district have not been found able to make fortunes much quicker than their apparently less fortunate brethren elsewhere. Although the elevation is not very sensibly above that of some parts of the Darjeeling Terai, the climate is much drier, and the district is subject to drought; so that regular flushes cannot be depended on. We do not anticipate, therefore, any considerable extension of tea cultivation in this district.

TEA IN KOTEGHUR.

AN attempt has been made to start tea cultivation in the Simla district, but to a very limited extent, and with but small success at present. The outturn (which is very small) goes to the Punjab market.

TEA CULTIVATION IN THE NILGIRIS.

IT is now several years since the culture of tea was commenced in the south of India; and at the present day it has reached a very respectable figure. At Kotagiri, Coonoor, and other places on the beautiful hills of the district, the tea bush is found to flourish remarkably well, and to possess, when manufactured, a full though fairly delicate flavour. The nearness of Madras to London by some few days is a slight element in favour; but still, prices at home have not reached as high as was expected; and less enthusiasm appears to be manifested now than when cultivation was first commenced. Planters in the Nilgiris labour under the disability, as we do here, of Government interference, restrictive rules regarding land, and indifference to the legitimate wants of settlers. There does not seem, therefore, much probability of any considerable extension of tea cultivation in those hills; and the gold fever which has set in is likely, indeed, to divert capital which might otherwise have been employed in Tea.

STATISTICAL TABLES OF INDIAN TEA CULTIVATION.

THE following tables represent the figures as far as obtainable, but they cannot be accepted as anything like perfect. Planters, in many cases, obstinately withhold all information, and it is doubtful if it will ever be practicable to produce a really reliable return. Another thing is, that Government do not employ, as they should do, a tea expert to check the statistics sent in to them. The result follows that many mistakes in classification and arrangement occur.

STATEMENT ILLUSTRATIVE of the STATE of TEA CULTIVATION in BRITISH INDIA during t[illegible]e l Years 1875-76, 1876-77, and 1877-78.

1	2	3			4			5			6			7			8			9			10			11		
					AREA IN ACRES.												APPROXIMATE YIELD IN LBS.											
PROVINCE.	DISTRICT.	NUMBER OF PLANTATIONS.			UNDER MATURE PLANTS.			UNDER IMMATURE PLANTS.			TOTAL AREA UNDER TEA.			TAKEN UP FOR PLANTING, BUT NOT YET PLANTED.			BLACK.			GREEN.			TOTAL.			AVERAGE YIELD IN LBS. PER ACRE OF MATURE PLANTS.		
		1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.	1875-76.	1876-77.	1877-78.
					Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres	Acres.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs	lbs.	lbs.	lbs.
	Cachar	162	162	206	24 662	28,837	31.833			9,078	24,662	28,837	40,911	117,207	121,074	102.048			8,410.116			...	7,233,213	7.191.309	8,410.116	295	249	264
	Sylhet	11	25	58	2.267	5,621	8,632			10,928	2,267	5,621	19,560	4,669	21,533	37,134			870,270			...	173,026	673,466	870,270	76	120	101
	Goalpara	7	8	6	79	112	60			136	79	112	202	75	1,085	797			15,320			...	8,217	7,201	15,320	599	64	232
	Kamrup	53	72	67	4 099	5.078	3,071			1,822	4,099	5.078	4,896	13,717	13,040	7,224			712.983			58,507	544,699	664,675	771,490	205	221	251
ASSAM† ...	Darrang	95	95	104	9,615	10,935	9,332	Included with mature plants.		3,515	9,615	10,935	12,817	41,078	40,191	56,908	*	*	3,356,626	*	*	...	2,245,344	2,800,854	3,356,626	358	412	360
	Nowgong	49	51	65	5,929	6,598	4,075			2,930	5.929	6.598	7.965	11,869	14.568	15,085			1,351,664			3,000	880,094	1,105.517	1,354,664	149	168	273
	Sibsagar	151	172	169	27,133	28,690	25,000			5.322	27,433	28,690	30.421	92,159	85,118	87,674			7,720,175			10,616	6,428,831	7.226,663	7,730,791	234	251	308
	Lakimpur	109	112	116	12.788	16,036	16.381			7,045	12,788	16,036	22.426	80,341	75,157	90,866			5,639,421			...	2,497,130	3,730,083	5,639,421	103	199	367
	Khasi and Jaintia Hills ...	3	5	5	435	804	779			199	435	804	978	278	453	1,079			203,600			...	12,306	87,328	203,600	28	203	261
	TOTAL ...	640	702	786	87,307	102,711	99,171	...	..	40,975	87,307	102,711	140,146	361,393	372,849	398,815	...	...	28,280,175	...	...	72,123	20,028,890	23,403,099	28,352,298	229	228	286
	Darjeeling	121	132	142	14,954	15,695	18,120	7,298	9,333	7,965	22,162	25,628	26,085	79,113	81,609	9,153	4,610,758	4,181,622	5,250,910	...	...	...	4,610,758	4,181,622	5,250,910	269	218	350
	Julpigoree	3	13	21	...	23	233	288	795	2,087	288	818	2,320	1,453	3,395	4,751	5,600	29,520	33,139	...	...	...	5,600	29,520	33,139	...	240	225
	Dacca	6	6	6	29	29	29	3	2	2	32	31	31	...	...	...	4,660	3,722	5,311	...	...	...	4,660	3,722	5,311	161	128	161
	Mymensingh	2	2	‖1	54	53	...	...	...	...	54	53	...	...	...	...	5 371	3.517	...	...	...	...	5,371	3,517	...	100	66	...
BENGAL ...	Chittagong‡	19	20	20	936	826	814	699	1,072	767	1,635	1,898	1,581	24,724	13,495	12,280	*	*	239,620	*	*	164	*	*	239,781	*	*	320
	Noakholly	1	1	2	15	15	155	1	1	60	16	16	215	8	8	245	320	520	39,800	40	80	...	360	660	39,800	20	40	245
	Chittagong Hill Tracts ...	4	1	5	439	220	112	613	230	178	1,052	450	290	286	2,166	236	160,760	46,571	16,000	...	...	...	160,760	46,571	16,000	366	211	395
	Hazareebagh	3	3	4	617	668	690	72	50	145	719	718	835	...	...	45	93,054	47,717	83,874	1,783	...	...	94,837	47,717	89,871	144	71	164
	Lohardugga	11	21	20	210	320	309	180	910	589	420	1,230	898	1,234	2.276	3.374	58,880	67,610	91,000	...	...	...	58,880	67,610	91,000	215	230	242
	TOTAL ...	170	199	221	17,314	17,849	20,462	9,064	12,393	11,793	26,378	30,242	32 255	106,818	102,891	30 387	4,939,403	4,380,799	5,768,654	1,823	80	164	4,941,226	4,380,879	5,768,818	285	245	263
NORTH-WESTERN PROVINCES	Kumaun§	13	10	*	1,456	1,457	2,055	755	765	245	2,211	2.222	2,300	1,699	1,689	2,386	94.551	64,104	226.483	183,871	196,956	107,264	278,422	261,060	333,747	183	169	162
	Garhwál§	1	4	*	13	13		...	...		13	13		...	...		4,648	4,891		...	...		4.648	4.891		357	376	
	Dehra Dun	13	16	*	1,687	1,874	2,140	452	600	940	2,139	2,471	3,080	1,949	1.780	3.172	202,112	358,812	463,989	146,000	74,400	114,384	348,112	433,212	578,373	194	217	221
	TOTAL ...	27	39	*	3,156	3,344	4,195	1,207	1,365	1,185	4,363	4,709	5,380	3.648	3,469	5,558	301,311	427,807	690,472	329,871	271,356	221,648	631,162	699,163	912,120	245	251	192
PUNJAB ...	Simla	1	1	1	120	120	75	...	...	25	120	120	100	...	...	...	*	*	3.000	*	*	...	8,170	7,484	3,000	68	62	40
	Kangra	¶ 850	¶910	¶1.041	2,579	2,789	4,200	1,547	1,822	2,461	4,126	4,611	6.661	1.201	1.773	3,275	550,429	585,213	667,572	121,350	137,875	187,848	671,779	723.088	855,420	200	200	200
	TOTAL ...	851	911	1,042	2,699	2,909	4,275	1,547	1,822	2,486	4,246	4,731	6,761	1,201	1,773	3,275	...	...	670,572	...	...	187,848	679,949	730,572	858,420	252	251	201
MADRAS ...	Nilgiris	38	44	53	1,614	1,614	1,907	878	1,628	1,362	2.392	3,142	3,269	641	2.341	3,681	220,070	233.769	226,389	...	2,000	...	220,070	235,769	228,389	145	166	118
BRITISH BURMA...	Akyab	1	1	1	120	120	120	30	30	30	150	150	150	100	100	300	25,000	18,000	25,000	...	...	...	25,000	18,000	25,000	200	150	209
	TOTAL BRITISH INDIA ...	1,727	1,896	2,103	...	...	130,130	...	...	57,831	124,836	145,685	187,961	473,801	483,423	442,016	...	...	35,661,263	...	...	481,783	26,526,317	29,557,482	36,143,045	...	...	...

* No information available.

† For 165 plantations in 1875-76, 146 in 1876-77, and 227 in 1877-78, the figures are merely estimates, no returns having been received from the Managers. The figures in column 11, for the years 1875-76 and 1876-77, are not trustworthy owing to want of complete figures for the area of land under mature plants.

‡ Not including some plantations existing in 1876-77 for which no returns have been received.

§ The figures for 1876-77 are exclusive of 6 plantations in the Kumaun District and three in the Garhwal District.

‖ The cultivation has been stopped since 1876-77.

¶ Includes small plots of Tea owned by natives.

NOTE.—The figures in column 11 do not in all cases correspond with those obtained by dividing column 4 into column 10, owing to errors in the local returns from which this table has been compiled.

STATEMENT ILLUSTRATIVE o[illegible] STATE of TEA CULTIVATION in BRITISH INDIA during the Calendar Years 1878 and 1879.

1	2	3		4		5		6		7		8		9		10		11		12	13
				AREA IN ACRES.								APPROXIMATE YIELD IN LBS.									
PROVINCE.	DISTRICT.	NUMBER OF PLANTATIONS.		UNDER MATURE PLANTS.		[illegible]DER IMMATURE PLANTS.		TOTAL AREA UNDER TEA.		TAKEN UP FOR PLANTING, BUT NOT YET PLANTED.		BLACK.		GREEN.		TOTAL.		AVERAGE YIELD IN LBS. PER ACRE OF MATURE PLANTS.		DISTRICT.	PROVINCE.
		1878.	1879.	1878.	1879.	1878.	1879.	1878.	1879.	1878.	1879.	1878.	1879.	1878.	1879.	1878.	1879.	1878.	1879.		
				Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
ASSAM† ...	Cachar	173	169	34,742	36,736	7,457	6,776	42,199	43,612	92,551	84,077	8,094,555	9,096,405	720	50,584	8,095,275	9,146,989	233	248	Cachar	ASSAM.†
	Sylhet	65	75	8,904	10,576	5,809	7,387	14,713	17,963	39,126	57,375	1,222,113	2,326,823	144,001	144,000	1,366,114	2,470,823	154	233	Sylhet	
	Goalpara	7	8	98	162	172	192	270	354	737	3,748	19,356	25,190	...	...	19,356	25,190	198	155	Goalpara	
	Kamrup	80	104	4,856	5,407	2,143	2,322	6,999	7,729	12,435	12.615	681,384	733,474	648	48	682,032	733,522	140	135	Kamrup	
	Darrang	113	120	10.015	11,277	4,110	6,250	14,125	17,527	51,485	67,331	3.535,433	3,517,359	640	...	3,536,073	3,517,359	353	311	Darrang	
	Nowgong	93	130	6,648	6,039	3,676	3,353	10,324	9,392	32,695	47,395	1,626,395	1,566,738	...	...	1,626,395	1,566.738	215	259	Nowgong	
	Sibsagor	197	211	27,968	30,159	6,226	6,619	34,194	36,778	112.877	120,299	8.272,142	9,703,932	10,056	17,892	8,282,198	9,721.824	296	322	Sibsagar	
	Lakimpur	116	102	15,500	11,778	8,281	5,006	23,781	16.784	93,527	59,959	4,677,548	4,086,191	...	...	4,677,548	4,086,191	302	346	Lakimpur	
	Khasi and Jaintia Hills ..	6	5	846	551	389	20	1,235	571	836	1,579	224,557	118,000	...	...	224,557	118,000	265	214	Khasi and Jaintia Hills ...	
	TOTAL ...	850	924¶	109,577	112,685	38,263	37,925	147,840	150,610	439,569	454,369	28,353,483	31,174,112	166,065	212,524	28,509,548	31,386,636	260	278	TOTAL.	
BENGAL ...	Darjeeling	141	152	19,210	21.117	7,096	7.073	26,306	28,190	8,051	9,137	7,525,980	5,126,460	...	...	7,525,980	5,126,460	391	242	Darjeeling	BENGAL.
	Julpigoorie	29	37	710	1,813	2,895	3,356	3,605	5,169	4,828	5,910	199,226	411,580	...	...	199,226	411,580	280	227	Julpigoree	
	Dacca	6	[illegible]	30	30	1	1	[illegible]1	31	...	...	2.663	2,822	854	...	3,517	2,822	115	92	Dacca	
	Chittagong	29	**29	2,170	1.412	1,182	1,075	3,352	2,487	*	8,120	690,929	535,145	...	...	690,929	535,145	318	378	Chittagong	
	" Hill Tracts‡ ...	2	4	100	12	130	262	230	274	630	5,084	32,000	*	...	...	32,000	*	320	*	" Hill Tracts‡ ...	
	Hazareebagh	4	6	690	734	201	210	891	944	63	2,350	78,412	65,455	...	...	78,412	65.455	114	89	Hazareebagh	
	Lohardugga	21	23	358	438	935	1,135	1.293	1,573	3,195	3,589	59,275	82,189	29,689	...	88,964	82.189	248	187	Lohardugga	
	TOTAL ...	235	257	23,268	25,556	12,440	13,112	35,708	38,668	...	34,190	8,588,485	6,223,651	30,543	...	8,619,028	6,223,651	370	243	TOTAL.	
N. W. PROVINCES ..	Kumaun§	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Kumaun§	N. W. PROVINCES.
	Garhwal§	*	*																	Garhwal§	
	Dehra Dun	*	23	2,043	2,347	1,329	1,109	3,372	3,456	3,167	3,501	554,044	109,426	174,053	576,200	728,097	685,626	356	292	Dehra Dun	
	TOTAL ...	*	*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	TOTAL.	
PUNJAB ...	Simla	1	1	75	75	25	25	100	100	...	...	3,000	15,000	...	...	3,000	15,000	40	200	Simla	PUNJAB.
	Kangra...	1,173‖	1,188‖	4,183	4,383	3,568	3,754	7,751	8,137	2,600	2,747	533,694	542,761	157,894	177,996	691,588	720,757	165	164	Kangra	
	TOTAL ...	1,174	1,189	4,258	4,458	3,593	3,779	7,851	8,237	2,600	2,747	536,694	557,761	157,894	177,996	694,588	735,757	163	165	TOTAL.	
MADRAS ...	Nilgiris	69	79	2,543	2,543	1,648	1,628	4,191	4,171	3,011	4,831	615,406	645,126	...	...	615,406	645,126	242	253	Nilgiris	MADRAS.
BRITISH BURMAH ...	Akyab	2	2	150	150	20	20	170	170	80	80	17,000	17,000	...	...	17,000	17,000	112	113½	Akyab	BRITISH BURMAH.
	TOTAL BRITISH INDIA ...	2,330	2,474	141,839	147,739	57,293	57,573	199,132	205,312	465,194	499,721	38,665,112	38,727,076	518,555	966,720	39,183,667	39,693,796	...	...	TOTAL BRITISH INDIA.	

* No information available.

† For 167 plantations in 1878, and 71 plantations in 1879, the figures are merely estimates, no returns having been received from the Managers.

‡ Two gardens in Noakholly and four gardens in the Chittagong Hill Tracts have, during the year 1878, been included under Chittagong.

§ The returns for this Province are defective as, with one exception, the planters of Kumaun and Garhwal failed to furnish the information for which they were asked.

‖ Of these, about 40 are large plantations, the rest are small plots owned chiefly by natives.

¶ Besides these, there are 161 gardens for which no information is available.

** Figures for 8 of these gardens not having been furnished by the Managers, are incomplete.

Statistical Review of the Tea Industry in India for 1879.

DISTRICT.	Number of Gardens.	Area under Tea. Mature.	Area under Tea. Young.	Area under Tea. Total.	Outturn lbs.	Average Area of Yield per Garden.	Average Area of Yield per Acre.	Estimated Capital invested.	Estimated Value.	Outturn Capital. lbs. R.	Net profit of produce.	Average Rate of Interest.	Average Elevation.	Average Rainfall.	Mean Annual Temperature.	Mean Annual Moisture
Assam, Cachar	180	42,453	3,782	46,235	10,613,250	256	250	22,861,100	31,220,900	: 2·1	1,989,985	8·9	100′-300′	121·078	75.4	75
Darrang	101	12.819	1.114	13,933	4,114.840	138	321	6,102,750	9,921,600	1 : 1·4	771,532	12·6	200′	76·17″	76 3	69
Kamroop and Goalpara	58	3,750	1,205	4,955	825,000	85	220	1,078,500	2,507,000	1 : 2·4	206,250	10 4	200′	69·23″	75·0	73
Luckimpore	212	19,843	3,516	23,359	6,230,702	110	814	10,976,300	15,648,100	1 : 1·8	1,149,507	10·4	250′-300′	116 43″	74·5	74
Nowgong	66	6,516	1,986	8,502	1,596,420	130	245	3,853,800	4,504,000	1 : 2·4	293,080	7·6	200′	82·50″	75 0	71
Sibsagor	216	31,317	3.131	34,448	10,021,440	180	320	16,597.800	26,306,000	1 : 1·6	1,879,020	11·3	200′-300′	95·50″	72·7	82
Sylhet	89	10,858	7,218	18,076	2,779,648	203	256	7,189,448	12.295,400	1 : 2·3	694,912	9·6	150′-250′	153·80″	71 8	89
Chittagong and Arracan	40	2,882	1,424	4,306	504,350	107½	175	1,261,600	2,308,800	1 : 2·5	94,566	7·5	30′-200′	105·61″	77·4	79
Darjeeling and Julpigoorie	189	28,741	5,280	34,021	5,548,200	185	193	13,080.400	19,356.600	1 : 2·3	866,906	6·6	300-5000	119·252″	53·9	82
Chota Nagpore and Chumparun ...	47	1,051	2,100	3,151	170,262	79	162	735.300	1,155,500	1 : 4·3	63,848	8·7	2000′	47 84	74·3	59
Dehra	85	3,943	263	4,206	630,880	120	160	1,235,500	1,853,250	1 : 4·3	98,575	8 0	2232	70·06	70·3	58
Kumaun	76	6,897	460	7,357	1,103,520	97	160	2,161.100	3,161,650	1 : 2·0	172.425	8.0	2300	48 61	65·8	55
Kangra, Mundi, etc....	54	3,957	368	4,235	633.120	80	160	1,260,700	1,891,050	1 : 2·0	98,925	8·0	2000-3000	42 16	60·4	61
Assam Province	922	127,556	21,952	149.508	36,181,300	162	284	69,059,698	102,411,000	1 : 1·9	6,984,286	10·01	200	102·10″	74·3	76
Other Districts	441	47,471	9,895	57,866	8,590,332	·129	181	19,734,600	29,726,850	1 : 2·4	1,425,245	7·23	2000	72·25″	67·0	64
Grand Total ...	1,363	175,027	31,847	206,874	44,771,632	151	256	88,794,298	132,137,850	1 : 2·0	8,409,531	9·47	.. ...	87 17	70·6	70

Note 1.—For export to Europe say ... ... 41,500,000lbs.
" " " Central Asia say ... ... 500,000 "
" Indian consumption " ... ... 2,771,632 "

Total ... 44,771,632 lbs.

Note 2.—Temperature, Assam ... Max. 135° ... ... Min. 42° ... ... Diff. ... 93°
Other Districts " 145 ... ... " 31 ... ... " ... 114

Note 3.—About 1,200 Europeans and 300,000 Natives form the immediate staff to keep this vast machinery agoing, and above 250 lacs of rupees are annually expended on the score of it. This money is chiefly derived from England; and it must strike the most superficial observer, what an unmixed blessing the Tea industry is to the Native population; for whether the English profit and lose individually, the Natives can only be enriched.

Note 4.—When all the tea now planted out shall have come into bearing, and, if the yield be merely 320lbs. per acre, then India will produce near 70 millions pounds of tea! So that a careful filling up of vacancies and high cultivation would supply a progressive demand at the rate of 8 millions of pounds per annum.

Note 5.—A slight discrepancy is noticed between the areas in the map and the above statement. This is owing to the fact that the latter was printed somewhat later than the former, and is therefore more complete and accurate, as embodying information acquired just before going to press.

Note 6.—The Government of India in the Department of Revenue, Agriculture and Commerce has compiled a statement of areas under tea, but I have purposely refrained from looking at it, so as not to be swayed by it. I shall compare their statement and mine when this paper will have been published.

F. LINDE.

PART V.—PRODUCTION OF TEA IN OTHER COUNTRIES THAN CHINA AND INDIA.

THE STRAITS SETTLEMENTS.

JAVA.

JAPAN.

CEYLON.

AMERICA.

JOHORE.

JAMAICA, AUSTRALIA, MAURITIUS, S. ITALY, AND OTHER COUNTRIES.

PRODUCTION OF TEA IN OTHER COUNTRIES THAN CHINA AND INDIA.

In Simmonds' *Tropical Agriculture,* (published in 1877), a considerable space is devoted to the subject of Tea; but with our later information and more perfect knowledge of the subject as regards India, especially, most of the author's remarks are behind the times altogether. The following extracts, however, as regards tea culture in countries other than India, are so far interesting, and to a certain extent instructive. Tea in India we have treated in a separate Section.

The progress of the production of tea in other countries than China is necessarily interesting, as calculated to make the world more independent for its supplies.

Besides India, Java and Japan, in the East, where it has made such progress, efforts are making to introduce it in parts of Australia, such as Queensland and Victoria, in Jamaica and Mauritius.

From Ceylon shipments are increasing. It is said to be also cultivated in the Corea, Tonkin, and Cochin-China.

Parts of North and South America afford a field for tea culture. And it has been attempted with some degree of success in Brazil and parts of the United States.

Madeira, Teneriffe, Portugal, Spain, France, Algeria, Italy, Austria, Turkey, and the Crimea, might all grow tea, for their climates are quite suitable; Australia, Tasmania, and New Zealand are admirably adapted likewise, but they have little or no labour to bestow on such a cultivation.

So far back as 1844 some success attended the efforts of a private individual, M. Jaunet, in the cultivation of the tea plant in the island of Mauritius. Chinese labourers were employed to assist him in the further culture of this important plant, the expense being borne by the Colonial Government: others were also engaged for a similar purpose in the Botanical Garden.

At a later period Mr. Boyer, of Port Louis, succeeded in raising 40,000 tea trees, and expressed the opinion that if the island of Reunion would give itself up to the cultivation, it might easily supply France with all the tea she requires, which is but little. The black tea that has been produced in that island is of a good quality.—*Simmond's Tropical Agriculture.*

Straits Settlements.—Experiments were made in 1871 by the proprietors of the Alma Estate to introduce the tea plant. They have now some twenty-five acres in bearing, and the manager, who has had large experience in Assam and other tea-producing countries, considers that the trees have grown as well as could be desired, whilst the strength and flavour of the leaf are excellent; but he adds that its success as a profitable enterprise depends greatly on an abundant supply of Indian labour.

Java.—In 1826 some tea seeds sent from Decima, in Japan, by Dr. Von Seiboldt, were planted in the Botanic Gardens of Buitenzong. The plants having succeeded, the idea was entertained of commencing tea culture upon a large scale. The first plantation, of about 800 trees, was formed in 1827, and some specimens of tea from the first trees grown in the island were shown at an industrial exhibition held in 1828. A second plantation was formed at Caroet, in the regency of Preanger, the first being in the regency of Buitenzong. So successful was the progress made, that in 1833 the number of trees in the regency of Krawang was returned at more than 500,000. In Java, the best tea, with coffee, is grown at a height of 3,000 to 4,000 feet above the level of the sea. It is on the slopes of the mountains in the residencies of Preanger, Bagelin, and Banjoemans that the finest plantations of tea are found. The leaves are gathered after the second or third year. Up to 1842 tea was cultivated in Java exclusively on Government account, under the superintendence of its officials. There were then 13,500,000 tea trees.

The number of labourers required for the culture and preparation of the tea was so large, the supervision so difficult, and the result so unsatisfactory, that the Government resolved to relinquish some of its plantations to private individuals, undertaking to buy the tea of them at a fixed price. This resulted in an extension and improvement of the cultivation, but the purchasing price was found too onerous for the Government, and the contracts were annulled after seven years' trial. The consequence of this was, that the cultivation of tea was abandoned in all but the regencies of Preanger and Bagelin, and the districts of Buitenzong and Krawang. It was found that private individuals were able, when left to themselves, to grow on more favourable terms than the Government, for while the former obtained 2lbs. of tea from seven or eight trees, the latter only obtained 2lbs. from thirty-three trees. In 1860, therefore, the Government gave up its last plantation in the regency of Bagelin Now that it is left to its own energy without government control or aid, it succeeds better.

In 1854 the island had 14,307,768 tea plants, from which 1,547,458lbs. of tea were delivered to commerce. Nothing can be more attractive than these tea plantations, each containing from 70,000 to 100,000 trees, and

giving occupation to from twenty-five to thirty families of native labourers. The seeds are sown in nurseries, from which the young plants are planted out in line at a distance of about four feet from each other. The tree is not allowed to exceed one and a half to two feet in height. The gathering of the leaves takes place in the rainy season at the age of two years. Both black and green teas are made.

TEA PLANTING IN THE STRAITS.

MR. WALTER KNAGGS, a planter of Province Wellesley, and whose name may not be unknown to our readers in connection with the agricultural resources of Perak, has addressed a very interesting communication to the *Penang Gazette* respecting the prospects of Tea Planting in the Straits. "I was asked," writes Mr. Knaggs, "a long time ago to put my ideas upon the prospects of Tea Cultivation on paper for the benefit of the public, and I cheerfully did so to the best of my ability, and in conformity with such experience as I had gained up to that time. I did not, then, assume to know much about tea, as I had but recently arrived in the Colony, and never saw a tea plant until I came in 1873. I then found that about ten acres of tea had been previously successfully established on the Estate, of which I had come to take charge, by my predecessor, Mr. de Mornay; and seeing its promising appearance, and guided, in a great measure, by the opinions of others who had been on Tea Estates in India (some of them old planters), I made up my mind to extend the cultivation as energetically as the means at my command would permit. I was not, however, able to begin planting out until late in the year 1874; and it must be borne in mind that the tea requires to mature for three years before it can yield a remunerative crop. My connection with the Estate in question has ceased; but I left about one hundred and fifty acres established and only requiring pruning to be ready for picking, and about one hundred acres of young tea which I planted during the fall of last year.

Eminent planters from India have visited and reported most favourably on the cultivation; and they have further expressed their surprise at the promising results that had been attained without any previous knowledge or experience—and further, their confidence in our prospects—as they say that the plantation will compare very favorably with many of those in India. My own confidence in the prospects of Tea Cultivation in the Straits is undiminished, the more especially as I have introduced a plan by which it may be planted, jointly with another article of Colonial produce, which, being gathered at the end of 18 months, will leave the tea established for nothing! This plan I have already tested, and I find it to answer completely.

The Malay Peninsula, from the Province to Singapore, contains millions of acres of low, undulating, thickly wooded hills. These are tea lands; and the soil of which they are composed tallies with the description that I have read of many of the most favorable tea soils in India. The variety to be planted must be the indigenous Assam and no other. With cheap land and plentiful labor, regular seasons, and easy transport—all of which we have here—I think that we possess advantages unequalled elsewhere; and I hope soon to see this cultivation largely extended. In fact I see no other permanent cultivation suitable for the lands in question but that of tea or coffee. Tea, however, has been made on the Estate which has realized in the home market the price of that of Assam, and which has been declared equal to it in every respect; but anticipating the great demand for seed which will probably arise, the trees are now being cultivated for that purpose; as it is not advisable to take leaves and seeds from the plant at the same time."

This would seem to be conclusive that tea can be grown in the Peninsula. Mr. Knaggs is a planter of experience, and although he may be perhaps a little sanguine, he has actually succeeded in growing tea, and his opinions are endorsed by others, eminent planters from India, and also by two of our own officials, the late Mr. Birch and the present Colonial Secretary, whose knowledge of planting in Ceylon ought to have qualified them to judge.

* * * * *

The success of the Ceylon planters should be an encouragement to enterprise in the Straits. Mr. Knaggs may be said to have demonstrated that tea can be grown beautifully in the Peninsula, and indeed, for that matter, there seems every reason to believe that it might be grown in the island of Singapore, if it were set about properly. The soil of Singapore may be said to have been, until recently, very much under-rated, but it has been now demonstrated that not only pepper, tapioca and sugar, can be grown upon it and made to pay handsomely, and why should not tea, which is a hardy plant. At all events, there is no question about the Peninsula, and we apprehend that the great and real difficulty will be, not as to the growth of the plants, but as to the proper preparation of the leaf. This is the difficulty in India, and it is discussed as follows in a report on the tea plantations in the Neilgherries:—

"The manipulation and curing of the leaf is the most difficult part of the tea planter's work, and the value of the manufactured tea altogether depends upon the skill and care with which this is performed. It matters not that the leaf may have been produced under the most favorable conditions of climate, soil, and manure, if the curing is defective. The

great drawback to the general consumption of Neilgherry teas is their varying character, each plantation and garden producing different samples and qualities; they are thus to a great extent kept out of the wholesale market. If the tea planters, instead of each attempting to cure the leaf he produces, would raise the capital amongst themselves for establishing in each centre of tea cultivation large well-equipped factories in which the leaf of the district could be properly cured under skilled direction, they would be able to produce a tea of an uniform sample and quality, which could be sent in quantity into the wholesale market where it would take a definite position. One such factory could be worked at far less expense than the ten or a dozen small tea curing houses which it would displace; and under good management there would seldom be any more difficulty in conveying the fresh leaf to the factory than is now experienced in carrying it to the present curing houses."—*Straits Times.*

We have had shown to us a small sample of tea, grown on the plantation of a lady at Sirangoon.

The specimen of tea we are referring to came from a garden of 500 trees, which have been in full bearing for some years. Messrs. Knaggs and Wray have been trying in Province Wellesley for some time to introduce the culture of the plant, but not with much apparent success. Here, at Sirangoon, we have an interesting demonstration that tea will grow in Singapore, and that it will so grow as to make its cultivation a probably profitable investment, and thus increase the resources of the colony.—*Straits Times.*

TEA TRADE OF JAPAN.

Now, that the introduction of Indian tea into America is in contemplation, some particulars with reference to the tea trade of Japan will doubtless be of interest. The export from Hiogo and Osaka for 1878 was 10,245,898lbs., value 2,204,600dols.; for 1879, 14,029,433lbs., value 3,592,100dols., showing an increase of 3,783,545lbs., and of 1,387,500dols. value. Of the total exported 2,590,611lbs. went to Canada, and the remainder to the United States. The produce of this district has doubled itself within three years, and the extent of ground being laid out in plantations is still largely on the increase. Owing to the high price of green teas, and the ill-success of previous experiments in the manufacture of Congous, the latter were comparatively neglected. The few small lots that were made, however, left so profitable a return to the shippers that the prospect is held out of further attempts to renew this industry. From Kanagawa the annual exports are stated as follows:—New York, Boston, &c., 13,967,490lbs., San Francisco, 3,845,362lbs.; Chicago, &c., 2,456,110lbs.; Canada, 1,137,583lbs.; England, 490,285lbs.—total 21,896,830lbs., of the value of 4,562,998dols., and increase, as compared with the value in the previous year (1878), of 1,967,351dols. The average of the past year's business was satisfactory to all concerned, for, although the losses on the late shipments were heavy, the profits on the purchases in June, July, and August more than counterbalanced them. The quality of the leaf hardly came up to the average of previous seasons, and much of the tea received during October and November was very carelessly prepared. The making of black teas for the English market again decreased, owing to the poor results of the same to producers, as compared with those prepared for the American market. Over half of the tea business at Kanagawa is in the hands of English firms. At Nagasaki the quantity exported did not vary much from that of the two previous years. Of the tea brought to that port a large part was taken by native dealers for shipment for mixing purposes. The value of the exports from Nagasaki was 114,807 dols.—*Home and Colonial Mail.*

In *Japan*, tea is cultivated from Kiusiou to Niphon, up to the 39° of N. lat., but the zone found most favourable is from the 30° to the 35°, especially in the regions on the coasts of the interior sea.

THE TEA INDUSTRY IN CEYLON.

OUR own opinion of the tea industry remains as it ever was. We are confident that if care be taken in the make, success must attend the enterprise. No doubt, there is a good deal of inferior manufacture sent home, as evidenced by the miserably low prices realised at recent sales in London. But all this will be corrected gradually and surely, and we shall expect, during the present year, to see large shipments of a better article to the Australian Colonies, where it is evident that a ready market will be found for all really good teas. The rates recently obtained for the China article noticed in a late issue, are not to be taken as a criterion of the actual state of the market. According to that list the largest sales effected during the last half of 1880 realised not more

than about a shilling a lb., the quantity sold at 1*s*. 6*d*. having been very small indeed: but most of these China teas shipped to the Southern Colonies appear to have been the sweepings of Foo-chow stores. There is no doubt that we may confidently reckon upon good useful teas from Ceylon realising 1*s*. 6*d*. and upwards, and these prices, we need hardly remind our readers, will leave the makers a very fair profit. Nevertheless good as the prospects of the Ceylon tea industry are, we entirely agree with our correspondent that economy in the early working of tea estates is essentially necessary; an utter disregard of this excellent rule has been the cause of much of the present trouble and complications with tea estates and tea companies in India. Their present trouble should be our warning.—*Ceylon Observer.*

TEA CULTIVATION IN AMERICA.

THE first tea was planted in this country in the State of South Carolina before the war. During the war it grew wild, as it received no attention. Commissioner Le Duc went there afterwards and gathered some of the seeds and replanted them. And Mr. Jackson, who had spent seventeen years in China, and acquainted himself with the process of manufacturing tea, took some of Le Duc's tea leaves and made them into very good tea. So, if proper attention is given to the subject, all the tea we want, and of good quality too, can be made at home, I believe.—*An American Tea Broker.*

THE Washington correspondent of the *New York Tribune* gives a summary of a pamphlet treating of the culture of the tea-plant in America, which has been prepared at the Agricultural Department, under the supervision of General Le Duc, the Commissioner. Quoting from Treasury statistics, which show that the value of the annual importations of tea into this country from China and Japan amount to about 20,000,000 dols. in coin, the Commissioner expresses the belief that the payment of this large sum to foreign countries can be avoided. He thinks that the United States can at least compete with those countries for its local consumption, even if it cannot rival them in supplying foreign markets. The pamphlet gives a detailed history of the cultivation of the tea-plant in the East, and then continues: "The latitudes in which tea is successfully cultivated in China, Assam, and Japan correspond with those of the States of Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Tenessee, Kentucky, Arkansas, Missouri, and a portion of the Pacific Coast, and the conditions of temperature of the soil are also about the same. Successful experiments in tea culture, already made in several of the States mentioned, simply justify the opinion that it can be made an industry in this country of immediate advantage and profit. A little calculation will show the profits which may be derived from an acre of land containing 2,000 tea-plants three years old. The third year the yield should be 187lbs., the fourth year 312lbs., the fifth year 500lbs., and the sixth year 750lbs. per acre. When the leaves are abundant one person can gather 16lbs. per day, but the average result of a day's work may not exceed 10lbs. or 12lbs. The leaves are gathered at three different periods, ranging from March to September, and on an acre yielding 500lbs. the first picking would be about 120lbs., and could be gathered by four persons in two days. The same number could pick the two crops in three days." Many extracts from letters written by farmers in the localities named above are given with the report, and the Commissioner thinks they justify the opinion that the practicability of the cultivation of the tea-plant successfully in the United States is no longer a matter of doubt. On the subject of preparing the tea-leaves for use, the report says: "As a business, and in competition with the cheap labour of the Chinese, it would be an experiment in this country, especially as regards the coarser article. As the finer teas rarely leave China, and the finest never, there would be no competition in these grades if the manipulation of the leaves is carefully and successfully attended to, while the possibility that modern methods and appliances might be substituted for the tedious hand work of the Chinese, seems to promise sufficiently well to make the experiment a wise one." The conclusions reached are that, whether or not the cultivation and curing of tea can ever become an industry in America. It is plain that there are thousands of families who may profitably cultivate tea gardens, and enjoy the fruit of them as they do that of the orchard or the berry patch, at the same time that they have the agreeable sensation of drinking a beverage never before known in their country, prepared from a grade of tea worth in China and Japan from 5dols. per pound. The culture of the tea-plant is not a new idea in the United States, nor does the Commissioner claim it to be an original one with him. Dr. Junius Smith made very careful and extended experiments with it at Greenville, S.C., about thirty years ago, and reported his success in the Patent Office reports from 1848 to 1859. The same experiment is now being repeated in California by a colony of Japanese.

TEA IN JOHORE.

I HAVE recently visited the little patch of tea trees planted at Johore for His Highness the Maharajah, and was much pleased with what I saw. The little garden is under charge of a Chinaman, who, however, does not treat the plants as we do in India; neither is his manufacture conducted on the same plan. The soil is of a reddish yellow color, soft, without clay or stone, of a friable nature, through which the frequent showers of rain easily percolate. The growth of the plants, considering their age, is most rapid and luxuriant. The leaf is soft and bright, and most healthy in appearance; the trees being almost entirely free from blight of any description. The jat (kind) is a good one, Assam hybrid, I should say from its appearance; the seed was sent from Assam by Dr. Barry. The climate is apparently all that could be desired for tea, and during my visit I had no difficulty at all in withering or fermenting without artificial heat.

During my stay at Johore, I manufactured some tea, samples of which (Pekoe and Pekoe Souchong) I am sending by this mail to a good firm of London brokers and tea tasters for their opinion and valuation, and the reports will be sent direct to Singapore.

About the tea I made I will say nothing at present, awaiting the verdict of the London brokers. I am myself satisfied, and have no hesitation whatever in prophesying a successful future for tea planting in Johore. The London and Calcutta tea markets have for the last eighteen months been bad for all classes of tea, Indian, China, good, bad and indifferent. The causes of this are various, but no doubt prices will, in a year or so, recover themselves. If an average price all round of 1*s*. 4*d*. to 1*s*. 6*d*. per lb. for the whole crop could be guaranteed, there could be no possible doubt but that tea in Johore would pay handsomely.

I hear from residents here and from the coffee planters, that the labour supply (Chinese and Malay) is good, fairly abundant and to be relied upon. This, I need scarcely add, is an indispensable item.

WALTER LANGLEY.

SINGAPORE, 11*th December* 1880.

PART VI.—NEW MARKETS FOR INDIAN TEA.

NEW MARKETS FOR INDIAN TEA.

THE *Tea Gazette* has not ceased for some two years past to direct the attention of those interested in Indian tea to the desirability—nay necessity—of opening up new markets for our produce. At length, recently, the agitation which we originally commenced, and have so earnestly and constantly striven to bring to some effect, has taken substantial shape and form in the establishment of a Tea Syndicate amongst the agency houses of Calcutta, whose avowed object is to ascertain the necessities and capabilities of other markets than the single one India has hitherto limited herself to.

Government came forward liberally, and subscribed Rs. 10,000 towards the project,—more especially, however, in connection with the Australian Exhibition; and further funds from Companies interested in the tea enterprise, as well as contributions in kind from various estates having been secured, a well-organized attempt was made the other day to adequately represent Indian tea at the Melbourne Exhibition. The result has proved not only instructive, but in a pecuniary sense profitable, and the Syndicate's agent employed to represent the interests of Indian tea in Australia has been able to afford suitable advice as to the class of teas in demand in that Market, as well as to give that information as to detail of arrangement in respect to mode and character of supply, which is so necessary to secure ultimate success in a new venture of this kind.

The two leading articles immediately following these remarks were written before the Syndicate came into being; but it is believed that they will be read with interest as indicating the lines upon which the experiment advocated should be followed. The experience gained by the Syndicates representative, supports, it will be seen, the view we then took of the subject.

THE TEA MARKET IN AUSTRALIA.

IN view to the more speedy development of the Indian tea trade with the Australasian Colonies, it may be useful to consider how the Colonial tea brokers regard the scheme, which, if successful, will cause a change in their business,—the change being attended at first with considerable inconvenience to them, if not loss of profit. It should not be lost sight of that this is not the first occasion on which India has courted her Australian cousin, and attempted to cut out the barbarian. But the courtship was so half-hearted as only to be recollected to be scoffed at. Now again the wooing has commenced, with considerable warmth too, and we await the result with some solicitude.

But Australia is not to be snatched at discretion from the embrace of China; she is both coy and diffident about changing her lover, and considerable tact and shew of superior advantage would seem to be necessary to win her for India. The China trade has taken deep root in the Colonies, and the tea-brokers carry on their large transactions with that country with the minimum of trouble and a maximum of profit. The grocers are satisfied with the tea, and so it would seem are the large majority of their customers.

Now, acknowledging the fact that most people are averse to change, even in smaller matters than a cup of tea, this contemplated change, where vested interests as well as settled use have to be attacked and subverted, can only be brought about gradually and by cautious steps. As regards the general public, the Indian commodity must be not only of better quality, but of not greater cost than good China tea. But even then the tea must be put before them; and this leads us to the difficulties now said to stand in the way of importing Indian teas into the Australian market.

The tea from China is neatly and strongly packed, so that a broken chest is almost unknown; and the chests or boxes are, also, always of even tare in each line. Thus trouble and expense on arrival of consignments at the Custom House is avoided. But with Indian consignments things are very different. The packages are unsightly, the chests are heavy, and their strength not proportionate to their weight;* and the tare is so uneven as to necessitate the opening of every package at the Custom House for weighment. This means both trouble and expense to the importer, a diminution of profit to him or to the grocer, or a higher price to the consumer,—the latter result being the probable arrangement. Sometimes (we fear often) the Custom House officers are saved the trouble of opening the chests from India, as they arrive ready opened. We are credibly informed that, as regards three recent consignments to Sydney, one of 29 chests, had 22 chests, and the others of 50 chests each had every chest broken,—some of them into splinters. Comment is superfluous.

It seems that each chest costs in the Customs for repair 2s. 6d. Beyond this is the certain deterioration of the tea in transit, by reason of exposure to the damp sea air resulting from broken chests; for not only are the wooden boxes smashed in, but so also is the lead lining in most cases,—the lead having in some instances disappeared altogether, if it was ever put in. The wood of the Indian chests was measured in Sydney, and found to be three times thicker than that of which the China chests are made,—that is, the Indian was $\frac{9}{16}$ and the China only $\frac{3}{16}$, of an inch. But while the outside packing of matting of the latter is strong and elastic, the protection afforded by the covering of the flimsy gunny used in India is very small,—useful chiefly as a bag when the wooden box has been smashed up. The Indian is very much stronger, and so heavier, than the China lead; but the latter is quite strong enough for all practical purposes, as it arrives unbroken at its journey's end. On the other hand, where the Indian chests do happen to arrive in fair order, the lead lining are often found to be broken, by reason of the chests not being full, and there being a space left between the lead lining and the lid of the box, so that, on being turned over, the tea is forced by its own weight through the lead. Then, again, these chests if filled up would hold an additional 10 or 15lbs., and so a considerable saving would be effected in freight, which is nearly a penny a pound from Calcutta as against about one half-penny from the China ports.

In our opinion the Indian chests of 85 or 90lbs. are too large for the colonial export trade* being from their size and weight less adapted

* [Since the above appeared in type, we are informed that the P. & O. Co. absolutely refuse to receive larger packages of tea than half-chests of 40-lbs.—Ed., The Cyclopædia.]

than smaller packages for the shamefully bad treatment they receive at the hands of the P. &. O. Company; the roughest usage being at Ceylon in the trans-shipment.* But at this early stage of the trade, we would ask whether it would not be better to send down very much smaller packages? We are told that 5 and 10lb. boxes and 40lb. chests would find favor with the importers, who think they would be more readily taken by the grocers than chests; and the grocers are to be considered.

Coming, now, to the methods adopted for the introduction of Indian tea to the colonists, we at the outset, condemn as injudicious, if not as positively hurtful, and unjust to the many colonial gentlemen engaged now in the China tea trade, the wholesale manner in which they are being libelled in pamphlets and newspapers. Our object should be to carry the colonial brokers with us, and not set them against us by abusing them, and telling them that "*all* China teas are unwholesome and unfit for human food: you know this, and yet for gain you engage in this vile traffic, when, if you were honest, you would only deal in the pure teas of India." To set forth as publicly as can be the excellency and purity of Indian tea is one thing, and a good measure, but to publish that *all* China teas are adulterated and poisonous, is another thing, and as unwise as it is wrong. Wrong, because it is not true; and, unwise, because, knowing it to be false, those interested in the trade take steps to publicly prove it to be so. For instance, the *Melbourne Argus* republished, a few months ago, the result of some laboratory experiments made in 1877 with teas sold by the grocers of that city,—showing that at all events *some* of the samples were of genuine and unadulterated tea. Much damage, moreover, is done the Indian tea trade by the action of needy adventurers—Indian castaways—taking advantage of the present movement to go down to Melbourne and Sydney, and there pass themselves of as persons connected with the Indian tea gardens, or even as Indian tea merchants, or their agents. Capital being necessary for successful tea broking, these adventurers, having none, sooner or later collapse, but not before they have done harm, as well by collapsing and so giving the business they professed to be promoting a feeble aspect, as by local newspaper scribbling. But we would especially deprecate as most injurious anything like present competition among proprietors of gardens and firms in India for the sale of their teas, or any line of action on their part, the principal effect of which would be to assist *individuals* in the colonies to *commence* a wholesale business on the specious plea that such is a necessary preliminary to a successful inauguration of the trade, when, as a fact, such success can be best and quickest reached by working through the long established and well-known commercial firms already numerous in the colonies, and whose interest it is so vitally important for us to secure.

* [Since the above appeared in type, we are informed that the P. & O. Co. absolutely refuse to receive larger packages of tea than half-chests of 40-lbs.—ED., TEA CYCLOPÆDIA.]

CHINA *vs.* INDIA IN AUSTRALIA.

ON this point we publish an article from a gentleman of experience in Sydney, in which the views of the Australians may be presumed to be fairly set forth. There are some points, however, in the article which

seem to require correction, and others which are open to considerable argument and explanation. It will be seen that the writer speaks of Pekoes being "rolled from Congous." What are we to understand from this? Pekoe cannot be "manufactured" by any mode of "treatment." Pekoe tip is of itself a distinctive thing, being the upper bud, which, in a favourable season, is covered with down, or silvery white hairy fluff, like that seen on the bud of any pear or apple before it comes into full growth. China tea as sent to England (and we presume also as sent to Australia) is noticeable for the absence of this hairy bud: so how Congou can be made into Pekoe, or "hairy bud," is incomprehensible. Souchong, with us, is the third leaf below the Pekoe bud, and Pekoe Souchong means the leaf between the Pekoe and Souchong, and it is so called because in the sieving we cannot sort out all the Pekoe tips. Congou with us means the 4th or 5th leaf,—so coarse that it is now rarely manufactured. On examining China Congou that we have come across, we have found it a large greenish leaf, the stem only coloring red: we repeat, therefore, that from it Pekoe can hardly come. What with us is called "Pekoe" is the bud and the top leaf, separated by sifting from the bulk of the tea. Then our author speaks of aroma being conveyed to the China Pekoes by a scented flower; but our hill teas, which have the most delicious aroma possible, derive that aroma entirely from the soil and climate. We have no fragrant herbs, indeed, to scent with, were we inclined to follow the Chinese custom; and surely there cannot be a question which is the more preferable,—tea possessing inherent quality, flavour, and aroma, or tea to which these qualities are fictitiously imparted. To change one kind of tea into another (supposing it can be done at all) it would be necessary in the first place to steam or soften the leaf with hot water: this alone would reduce it from first class to very low class tea; and, if practised, clearly shows that the Chinese have to rely on a foreign flavouring body to replace the property which the teas they send forward to the home market have lost.

That adulteration or "conversion" of low class teas in China for the foreign markets is largely practised, we presume our author will not deny.* Still we agree with him that it does not follow that *all* China teas are adulterated; although we believe few of those shipped to our shores come up to the average of our better Indian growths. Adulteration, too, is unfortunately not confined to China: it used to be practised, as regards tea, very largely in England. In 1780, the East India Company were obliged to put forward a notice that they had nothing to do with the adulteration of tea in the 6 millions that they imported at that date; yet official inquiry showed that another 4 millions was made in England; and there, also, we know of pretty extensive adulteration of China tea with sloe-leaves and the like. Leaves which had been infused were re-dried,—a practice attributed largely to the Chinese in the present day. But while we can now claim, almost, that with us the adulteration of tea, (owing to its cheapness, probably) has ceased, it is on record beyond dispute that

* The Chinese, it is known, use *gypsum* to give weight and a sticky nature to the leaf; *plumbago* and *lamp black* to cover the white of gypsum; and ferruginous earth to deepen the red of the liquor. The authority for this is the late Mr. Fortune, who found out all this before five millions of Indian tea had been grown (See his Paper, "How China Tea is elaborated for the European Market."

the Chinese pursue a system of special "manufacture" for the "outer barbarian," which is far from being consistent with honesty, or compatible with health to the consumer. It is not long since that a large quantity of "tea" unfit for human consumption was seized by the Customs at home; and it is known that of the stocks in bond a good deal is fit only to be thrown into the Thames. Nor can we affect to be ignorant of the so-called "lie" tea, which consists of leaves and weeds rolled and dried, and artificially flavoured so as to resemble the genuine article. Again, green tea has for several years been almost entirely shut out from the English market, owing to the discovery, by the Government inspectors at Somerset House, of the extent of its adulteration. We have recently come across a book published by Horniman and Co. (very large dealers in China tea) and professedly written by one Lo Fong Loh, Secretary to the Chinese Educational Mission in Europe, in which this question of adulteration is very plainly set forth, explained, and admitted; but it is also clearly stated that the teas made for home (China) consumption are of excellent quality and pure, while the kinds drunk by the Mandarins are of the very choicest character. What we would say, then, amounts to this—not that the Chinese cannot and do not make good tea, but that they favour us with very little of it.

We next come to the proper flavour of tea. This must depend upon the manner in which it is treated apart from the jât of the plant: but this does not vary much. We class them as roasted or unroasted, fermented or not fermented. As a rule the China teas are roasted, and fermented to the saccharine stage, because drunk, in China, without milk or sugar; while the Indian teas are not roasted, and only slightly fermented. This makes a very distinct classification. Roast meat, for instance, has a very different flavour to raw or unboiled meat. So it is with tea. From the peculiarity of its labour, and the habit of the country up to the present time, China teas are invariably roasted; so we must look to that flavour in the tea from that country. A Chinaman will not drink the colored tea supplied to England, which has totally lost the flavour of being roasted. Of all tea made in China, the best part is retained. The remainder, which goes to England, ought to retain the same flavour of roast; but it does not, and this requires explanation from China. We have only to look at the leaf after infusion to show that it is well fermented to the saccharine point, and therefore it cannot naturally have that extraordinary bitter flavour which we find it to possess. The adulterators attempt to supplant Indian tea by imitating its natural pungency. Indian tea is made slightly different to China; it is withered instead of roasted, and so has greater strength and pungency, and it is only half fermented so as not to lose the delightful tonic property; for Englishmen like their bitter beer, and are not enamoured of sugar to the extent, say, that Frenchmen are, who, for this reason, do not like tea, but prefer cocoa, chocolate, and coffee, in which boiled milk and sugar have a prominent place. The present bitter China tea, of which the prevalent flavour is tar, could not be supplied to Russia, for the simple reason that they do not drink it with milk, but with lemon and sugar, which of course assists somewhat to disguise the flavour. With Indian tea, pure milk from which the cream has not been taken

combined with sugar, brings out the delicious flavour of Indian tea.

Our author, it will be seen, refers to the circumstance of Indian teas possessing an "earthy" flavour. We are unable to understand this except upon the supposition that there has been carelessness and want of cleanliness in manufacturing, and that dirt has actually got sensibly mixed with the tea; but sieving would soon eliminate this, and determine the point. True, Indian teas have different flavours, but these are due to difference of climate and soil. Thus, Assam is different from Sylhet and Cachar, Cachar from Darjeeling, and so on,—each country possessing its special quality and variety, according also to whether the tea is grown on hill or plain. The hill teas of India more or less assimilate, but still even these are not identical. Another cause of difference is due to the family of plant,—the hybrid, which is Indian, being distinguishable from the China. No two gardens, even, can make alike, though adopting the same process; and in a factory where ostensibly the climate, soil, and leaf, are the same, the teas are different day by day, month by month, and sometimes different qualities are made during the same day; neither does bulking give the same uniformity that is to be found in China tea. We know that the China teas are faced, and there must be a standard quality of facing given to the leaf to secure the uniformity which prevails. The *natural* process of facing is so tedious and expensive, that it is rarely adopted in India, and we may be sure, therefore, is not at all adopted with the enormous yield of China. With all the differences we have mentioned above, it is not easy to acquire rapidly a true knowledge of Indian teas, and it is hardly to be wondered at if the brokers and tasters in Australia fail at first to do our growths that justice which we feel sure in time will follow. Our own brokers at first were by no means enamoured of Indian teas, until by experience they came to know the flavour, and understand and appreciate the variety of characteristics,—due to purely natural causes, and not, as in the case of China, an artificial uniformity foreign to the tea itself. A friend of the writer's has come into contact with a gentleman from China who had especial facilities afforded him for going into the tea-houses, and he invariably found them flavouring the tea by sprinkling on to the teas drying some liquid with a many-pointed broom. The habit of years has accustomed the English palate to this uniformity of flavour; and when our varied teas are placed before people, they at first fail to recognize their superiority, and attribute natural pungency and strength to rankness of flavour, while their tastes are not sufficiently educated to appreciate the exquisite delicacy of, say, the hill products of Kangra and Darjeeling. It is probable, therefore, that a judicious mixture of India with China will for some time be the best means of cultivating a taste in Australia for Indian teas,—a taste which it is foolish to expect to force, and it is equally unwise to try and convince Australia of the badness of China tea relatively to Indian by mere abuse instead of by argument, proof, and example. We imported our tea seed from China, but by our blending of varieties, we say we have decidedly superseded them; as the Australians, in the same way have, in the general class of horses decidedly improved on the English breed—for which they are entitled to great credit; and, as is well

known, the importations to India of horses from Australia now form a considerable item of trade.

There is one other point we would refer to, in way of explanation to the writer whom we have referred to. He says there is no analogy between the China "chop," and batches of Indian tea. Yes, there is. Our word "break" is almost synonymous; only the Indian "break" is any number of chests manufactured about a certain date: *i.e.*, it may be, say, the teas of April or May, in contradistinction to the plan pursued in China of mixing into one "chop" the teas of, say, April to November.

There are no doubt, as stated, 800 or 1,400 half-chests in one chop and sometimes even more; but this is the manufacture of perhaps two to four hundred small gardens, and therefore may represent as many qualities of tea, which it becomes necessary to assimilate the flavour of by artificial means. The superiority of the Indian system, therefore, in preserving the freshness of the tea by limiting the breaks to almost monthly packing, must be manifest.

We trust that our friends in Australia will see from the few remarks we have made that we have really reason to boast of our teas, and of the purity of our manufacture, and we can assure them that the more they know of them, the greater will be their approval.

CHINA *vs.* INDIA IN AUSTRALIA.

[The following article has been forwarded to us from Sydney for publication. It is interesting as showing the views pretty generally entertained on the spot, but we have thought it desirable, in a leading article (*see ante*) to draw attention to some error of argument, and to the view of the subject as held here.—ED., I. TEA GAZETTE]

THE China tea importers are fully alive to the injury which would be done to their business if Australasia became consumers of Indian tea, and already have taken steps to try to check the progress of our project, by increasing, if possible, the facilities for import, and by making marked improvement in the qualities of the tea exported. Now let it be not forgotten that up to this time of writing not one single member of any tea-house (Indian), nor agent, nor traveller, has yet paid a business visit to any of the Australasian colonies, and let it be known that the principals themselves of the China houses have not thought it beneath their dignity, or too much trouble, to come down *in propria persona* to take notes in view to meeting to a greater nicety the demands of those markets. The members of the China exporting houses (who are, we may remark in parenthesis, not, as is generally supposed, Chinese, but Englishmen) will always exert themselves to meet the fancies of the trade and the demand of the market: the rule being, Congous cheap, Pekoes plentiful; Congous dear, Pekoes scarce. This is easily arranged, as the expert Chinese operator can roll the tea into any form to suit the demand. If Congous are cheap, then it pays to roll into Pekoes, which bring 1*s.* or 2*s.* a lb. more. There is no analogy between the China and Indian teas in the matter of nomenclature. The China Pekoes, for instance, are artificial, so to say, being scented by a flower grown especially for the purpose; but it does not follow that the tea is adulterated by the admixture of foreign substances. It is, no doubt, this peculiarly aromatic scenting which so captivates the drinkers of China teas; the aroma of the Indian Pekoes and Pekoe Souchongs being decidedly "earthy," is not so enticing. We instance this as another difficulty in the way; for it is only by knowing what the difficulties are, that they can be met. Then again there is not only no term corresponding to the China term "chop" known in the Indian trade, but what is conveyed by the term has no existence. There may be 800 or 1,400 half chests of China tea in one "chop," the result being that only one chest is opened, and the whole of the rest sold on that sample. As against this take the Indian consignments, where there are sometimes half a dozen sorts in a consignment sent out of the country, invoiced as one specific sort of tea. It behoves the Syndicate and those here interested in the scheme to consider these matters with a view to improvement. It is absurd to suppose that the Australasian market is ready to drop, like a ripe plum, into the mouth of our tea-trading community. With great care, with considerable expenditure of time and money, and with untiring energy *judiciously expended*, those best able to speak say that the game may be carried to a fairly successful issue in from 5 to 7 years.

MAJOR CLEMENTI'S REPORT ON INDIAN TEA AT THE SYDNEY EXHIBITION.

SYDNEY.—Very great interest was taken in these exhibits. Japan exhibited some very good samples of Pekoe, Souchong, and Congou, of which I have kept samples; and Ceylon exhibited a large number and variety of very excellent teas; China did not exhibit. The judgment was by courts, and not general as it ought to have been. The results of the judging cannot be considered to be satisfactory—all my endeavours to obtain a fair and intelligent judgment having been thwarted. Mr. Ponder was really the only one of the judges that had a technical knowledge of tea, and he was appointed on my nomination, as I could not find any one else not exhibiting who had the experience of a professional tea-taster. But as he was engaged at the time in the business of a Sydney merchant, the agent for three exhibitors who were the Calcutta agents for a number of tea concerns, I considered that great caution was necessary, so that the judges should not know the names of the exhibitors or tea concerns until after they had given their judgment on the merits of all the teas, variety by variety. I therefore excepted to Mr. Ponder's proposal, that I should send to the judges' room samples for tasting, with the names of the gardens written on them, and I sent down the samples, variety by variety, in sample-boxes having only a number for a distinguishing mark. Accompanying the samples was a list, containing a key to the numbers, in a sealed envelope, addressed to the Chairman of the Committee, and marked, "not to be opened until after the judging." On one occasion an envelope so sent was opened in the absence of the Chairman, and the list was abstracted. This method took both time and trouble, and it was exceedingly disappointing to find that my endeavours had been frustrated by awards being given to the agent-exhibitors for collective exhibits of all kinds of teas from various tea concerns, instead of to particular tea concerns, and for the best of specific varieties of teas. Mr. Ponder was chiefly concerned in the judging, and was the judge entrusted with writing the report; and what he in effect did was to count in the Indian court the number of samples exhibited by different exhibitors, and then recommend these exhibitors, in such order as he thought fit, for prizes for their collective exhibits. In some cases very gross injustice was done, so it seemed to me, in the grading; and though among the collections of teas which received the highest award were undoubtedly some teas well deserving the award, yet it was very plain that the bulk of the samples in these collections were inferior to the superior kinds of teas sent down by other exhibitors, and which received only third and fourth awards. I represented the matter to the Committee of Judging and Awards, but the only concession that could be made was that each of the tea concerns, included in the collective exhibits, should receive a diploma, the medal going, I suppose, to the agent. The Government of Madras exhibited twenty-four samples, including nine varieties, and received a third award. These teas were exhibited in shallow boxes divided into twelve partitions each, with small pieces of glass, one for each partition, slipped in one over the other. This was by no means a good plan, as the least vibration caused the glasses to slide, and, even when properly adjusted, the teas were exposed to dust and air as there were open spaces where the glasses overlapped. Mr. W. Lee Kirby, Brooklands Estate, Nilgiri Hills, receives a second award for the six varieties exhibited by him. Messrs. Beg, Dunlop and Company exhibited eighteen samples, which included seven varieties of tea, and received a first award for the collection; the teas were well shown in large glass bottles arranged on a stand—in my opinion not only the most convenient but the best way of exhibiting teas. The two varieties exhibited by the Commissioner of Arakan received no award, though they were surely samples of no common merit. The Singbulli and Murma Company exhibited three varieties and four samples of Pekoes, receiving a first award. For the collection of thirty-five samples, which included eleven varieties of tea, a first award was adjudged to Messrs. Williamson, Magor and Company, whose teas were well shown in large glass bottles. The Kousanie Tea Company's exhibit included eight varieties of every high class teas, possibly equal to any shown, but they only received a third award. The six varieties shown by the Muka Ruttyoor Tea Concern were unsurpassed by other exhibits, yet they were adjudged only a fourth award. Messrs. O. Steel and Company sent down three varieties of teas in fourteen varnished teakwood chests, of which a trophy was made in the Indian court, glass being let into the front of one chest of each variety. The company received a fourth award. The teas of Messrs. Balmer, Lawrie and Company were well exhibited by their Sydney agents, Messrs. Clifford, Love and Company, in a handsome show case. There were nine varieties of as good tea as any shown, but they received only a second award.

Tea in Australia.

Public Auction Sales of China Tea in Melbourne for the half-year ending December 1880, (with synopsis of prices realized).

About 67,000lbs. sold at 7¾*d*. to 8*d*. per lb. in Bond.

106,000	...	8¼	„	8½
135,000	...	8¾	„	9
370,000	...	9¼	„	9½
376,000	...	9¾	„	10
308,000	...	10¼	„	10½
235,000	...	10¾	„	11
209,000	...	11¼	„	11½
199,000	...	11¾	„	1/
245,000	...	1/0¼	„	1/0½
170,000	...	1/0¾	„	1/1
163,000	...	1/1¼	„	1/1½
128,000	...	1/1¾	„	1/2
185,000	...	1/2¼	„	1/2½
135,000	...	1/2¾	„	1/3
132,000	...	1/3¼	„	1/4
44,000	...	1/4¼	„	1/5
50,000	...	1/5¼	„	1/6
46,000	...	1/6¼	„	1/7
46,000	...	1/7¼	„	1/8
38,000	...	1/8¼	„	1/9
4,000	...	1/9¼	„	1/10

3,391,000lbs.* total.

From this statement you will see that 2,005,000 pounds weight sold at and under 1*s*. per lb. in bond, and 1,386,000 pounds weight sold at and under 1/0¼ to 1/10 bond. This gives no idea of the sales of fine tea, which is usually disposed of privately, for it is found difficult to obtain over 1*s*. 8*d*. per lb. publicly for any class of tea.

The sales of tea outside of the Auction Room for the six months ending 31st December 1880, will probably amount to 2½ million pounds more, bringing up the total sales of China teas to not far short of six million pounds weight.—*Ceylon Observer.*

The Tea Trade in Victoria.

A large proportion of tea consumed in Victoria is sold in half chests 38lbs., Boxes 11lbs., with a few quarter chests 20lbs. weight. These packages are generally taken by the squatters, selectors, farmers, &c., just as received without any mixing and price generally guides the buyer, but he wont have posts and rails (*viz.*, large leaf and stalky samples) or dusty teas. A small quantity of finest quality is taken at any fair price by the wealthy classes; other balance of consumption consists of the trade of towns and retailers generally. Most of this class of tea is mixed, and therefore the weight of packages is not of so much importance, though the small retailers object to lay out too much money on heavy packages. A considerable amount of the mixing is primitive and varies with seasons. First the gentle and long suffering public is treated to Canton Gunpowder, &c., which has its day, then Canton scented caper has a turn, followed by Canton long leaf scented Pekoe. Now, Canton short leaf scented Pekoe and Kooloo teas are the fashion.—*Ceylon Observer.*

Consumption of Tea in Victoria.

From Hayter's Statistics just published, it appears Victoria can take 5½ millions ℔. of tea for home consumption for a year, and 4 millions of tea for export for a year or 9½ millions lb. in all.

The China Tea Trade with Melbourne.

The season generally opens here in June or July, and sales by auction are frequent from that period till the close of the year, or say for six months; after this time buying, as a rule, is reduced to supplying immediate wants—tea dealers keeping their stocks low and trying to clear out before the new comes in, in June.

For many years past buyers have found China teas keep badly, and when new season's musters are shown, old stock is reduced in value fully 2*d*. to 4*d*. per lb. on teas above 1*s*. per lb. in bond, and proportionately on lower priced grades, whilst frequently teas selling at 1*s*. 9*d*. to 1*s* 10*d*. in April-May realise only 1*s*. 2*d*. to 1*s*. 4*d*. in July-August. The cause is due entirely to the old teas being flat and stale when compared with even common chops of new Congous.

The usual course of the Melbourne Trade is to buy sparingly of medium to fine teas early in the season, or say during July to August, and such teas are almost entirely used for mixing, and to freshen up old stock therefore only a limited quantity is sold, and generally the best quality of the year. Very little of this new tea is sold straight to consumers because it is considered by them to have no strength, and too much flavour; the fact is Victorians have been educated up to a bad standard of tea.

First crop China teas are always the best liquor, though not in leaf. The bulk of these teas come forward in July and August, and most of them are sold privately. The heaviest sales and cheapest prices usually rule during September, October, and very little business is done January to May. Buyers often find their purchases made early in the season have gone off in quality, so a brisk demand is experienced as in the season for scented teas and other mixtures.—*Ceylon Times.*

OPERATIONS OF THE TEA SYNDICATE IN MELBOURNE.

THE sale of the first lot of the Syndicate Teas took place yesterday with a very satisfactory result, thanks to the good work Messrs. Jas. Henty & Co. have done in assisting me to look up the trade here, generally, both wholesale and retail, and also thanks to the publicity given to our project by the daily papers.

The afternoon teas at the exhibition did a good deal also towards helping the sale. They are a great success, so great that I have had to issue cards of invitation, as the general public are too strong for the resources of the Court.

The public will, I have no doubt, take our teas if the grocers will sell them at a reasonable price. A good opening has now been made, and it rests with the merchants of Calcutta to keep up a regular supply of the right qualities to make the trade with this colony a permanent and growing business. There is only a limited demand for the finer grades.

The prices realized for most of the teas are not extravagant, which I look on as a good sign. As they will most probably go into consumption quickly, and a demand will arise, I do not look for a lower range of prices, but this is a market which could very easily be swamped, as there is amongst a great number of the trade a distrust of the article, which it is difficult to overcome; however, with a steady supply of suitable kinds and patience I have no doubt our difficulties with such people will disappear. Small well-made Pekoes, Broken Pekoe Souchongs, and Leafy Broken Pekoe Souchongs, with tips, are the most suitable sorts to send, small boxes (about 10lbs. nett) and half chests (not more than 50lbs. nett) are the packages liked; the teas should be carefully bulked and weighed, but the weight not marked on the package, as there is some difficulty with the Customs.

I have been making enquiries about the chances of a trade with Sydney, but am not encouraged to send on a shipment there, and hesitate to do so until I have been to see whether the great prejudice which I am told exists against our teas is a reality or only a fancy. The Governor, Lord Loftus, was over here for the opening of the Exhibition, and desired me particularly to make an effort to open up the trade in his colony. He thinks there is a splendid chance for it, but from others I have a very contrary opinion.—*Mr. Sibthorpe's letter to the Calcutta Syndicate, dated Melbourne, October* 1880.

INDIAN TEAS IN THE AUSTRALIAN MARKET.

THE experiment of endeavouring to find a market for Indian teas in Australia has had very encouraging results. We have before us the report of the Calcutta Tea Syndicate's representative in Melbourne, from which it appears that the prices realised on the trial shipment of 2,259 packages of 113,689lbs. compare favourably with the rates ruling in the London market. The prices affixed to the teas at the time of shipment by a committee of Calcutta brokers were the full valuations according to the latest London advices at that time. Cachar Pekoe Souchongs valued at 1*s.* to 1*s.* 1*d.* per lb. up to 1*s.* 5*d.*, sold in Melbourne from 1*s.* 4½*d.* up to 2*s.* 0½*d.*, the last-named figures having been realised on a parcel from the Coombergram gardens. Broken Pekoe Souchongs, valued from 11*d.* per lb. up to 1*s.* 3*d.*, sold from 1*s.* 1½*d.* up to 1*s.* 7*d.* per lb. Pekoe, valued from 1*s.* 2*d.* to 1*s.* 6*d.*, sold from 1*s.* 11½*d.* to 2*s.* 0½*d.* per lb. Assam Pekoe Souchongs, valued from 1*s.* 1*d.* per lb., sold up to 1*s.* 6½*d.* per lb. Souchongs, valued from 11*d.* to 1*s.* 3*d.*, sold up to 1*s.* 4½*d.* Pekoe, valued from 1*s.* 7*d.*, sold up to 2*s.* 2½*d.* per lb. Darjeeling Pekoe, valued from 1*s.* 7*d.* up to 2*s.* 6*d.*, sold up to 2*s.* 7½*d.* per lb. Indian tea has been steadily growing in favour in Australia for some years past, and the opening up of a large competing market at the antipodes can scarcely fail to have a marked influence upon the value of the commodity in the London market and upon the remunerativeness of a promising branch of Indian industry.—*Grocer.*

THE AMERICAN MARKET.

A NOTE of alarm has been sounded in America by those interested in the China trade, and the burthen of it is, the unsuitability of Indian tea to the palate of the American tea-drinker. Well, we can quite believe that our teas will not, in their pure state, at first find favour in America and Canada; and we think that, to be successful in these, to us, new markets, we must "hold a candle to the devil," that is to say, we must

do what has been done in England, and is now, even, so extensively done,—we must *blend.* This, of course, we cannot do here. But we can arrange for it to be done on the spot; and we can and ought to suggest to American wholesale dealers the desirability of adopting this course.

It should be recognised as a truism that we must not go too violently against the preconceived opinions of the trade. Our object should be to persuade them, first of all, of the superiority of our brands; and next, of the profit which may result from utilizing them. In this way, the introduction of Indian tea into America and Canada may become of sensible account, whereas the forcing of pure Indian tea, on its own merits, on our Trans-atlantic brethren, may end in disastrous failure. What we have to do is to educate the public taste for our teas; but that cannot be done by giving them all at once that which their palates will not approve,—by reason of the circumstance that they have been accustomed to a less pure, pungent, and wholesome liquor. The change to be effectual can only be gradual,—as indeed it has been in England.

The Calcutta SYNDICATE is wisely sending an expert to America to ascertain the requirements and conditions of that market. Let him be instructed also to point out to wholesale and retail dealers the pecuniary advantage which has been found to result, in England, from the mixture of our pure growths with China. In this way we may obtain support; whereas, if we go in for rivalry pure and simple, the chances are,—the American taste not being as yet prepared for us,—we shall go to the wall.

INDIAN TEA IN AMERICA.

WE publish the following letter from a gentleman in New York who has been giving special attention and making enquiries relative to the question of the introduction of Indian tea into the American market. He writes:—

"In America all Indian teas are called Assams. Various small shipments have been made to New York and Boston, but hitherto the introduction has turned out a failure, in consequence of the teas not being the grade required for these markets. The flavour of Indian tea, as a rule, is too coarse and strong for Americans, and as no tea retailers in this country make tea a speciality, they do not understand, or will not undertake, the mixing of teas, a method so well known and carried out in England. In New York, which I am told is a guide throughout the United States, tea is retailed at a "grocery"—a store where, in addition to groceries of all kinds, bread, milk, fresh vegetables, wine, beer, liquors, mineral waters, wood, and frequently coals, are sold. In fact, an American grocery is a combination of an English-Italian warehouse—tea grocer, greengrocer, cheesemonger, and chandler's shop, with a dash of butcher and baker thrown in. You can easily understand from the foregoing why tea retailers do not understand the mixing of tea—it would cost too much time and trouble. There was another drawback against the success of these tea shipments alluded to—the packages were too large. The firm of brokers by whom I was given these particulars were of opinion that Indian tea must eventually become popular in America, and the use of it would be considerably hastened by consignors, whether from England or India direct, sending teas suitable to the American taste. The consumption of tea in this country is already very great and continually increasing. The teas mostly used in the United States, and which have the readiest sale, are Oolongs, Pekoe, flavoured Congous, same as Assam tea, Formosa tea, and Japan tea. The latter is becoming popular, especially in Western States, where the water is so much impregnated with lime. There are also teas from the north of China, fine Pekoe Souchong flavour, that are well liked. Should any of your subscribers anticipate making a consignment of Indian tea, carry out as far as practicable the following suggestions:—Select a crop of tea of medium strength, so that it can be used without mixing, and the flavour similar to the kinds such as I have told you are mostly used here. Have the tea put up in boxes or catties, so that dealers willing to try it can buy small quantities at first by way of experiment. *Price*—to cost wholesale at from 50c. to 60c. per lb., say from 2*s.* to 2*s.* 6*d.* sterling. A shipment of tea can be consigned to any responsible house. The consignee would

simply have to give instructions to a good firm of tea brokers and they would furnish a report. This report can be cabled or written back. Tea is admitted to this country free, provided it is shipped from the country where it is grown. Should it be transhipped, say from England, there is an import duty of 6 cents. per lb., equal to about 3*d*. sterling.—*Home and Colonial Mail.*

Our readers will doubtless like to know, in connection with the contemplated shipments of tea to America, what sort of price is likely to be realised in that market for teas of Indian growth. We have lately been favoured with the views on this point of a gentleman of great experience in New York as a tea agent, who knows the market and the American trade thoroughly. He assures us that the American taste for Japans is very pronounced, and that the teas of that country have obtained a firm hold in America. The 34.000.000lbs. of Japan tea used in America consist almost entirely of artificially faced greens. Besides these, other 16,000,000lbs. of China green tea are used. With these, he thinks competition would be very difficult. Of Congou or black teas only some 4,000,000lbs. are consumed. It is however as against teas of the Oolong class of which some 16,000,000lbs. are annually drunk in America, that Indian teas would find it easiest to compete. Oolong is a roughly made tea with an unassorted appearance of a light greenish colour. It is briskly fired and has a taking scent when crushed in the hand. In liquor, it draws a light coloured water and is pleasant to drink. Indian "Namuna" teas approach Oolong more nearly than other sorts of Indian growth; but as prepared for the home market they are not sufficiently fired to please the American taste. It would therefore, the authority in question thinks, be better to fire them somewhat more when intended for the American market.

Americans do not object to teas containing about 15 per cent. of dust, and it is therefore unnecessary to clean them so completely as is done for the London market. If carefully made an all round price of about 1*s*. 3*d*. per lb. may confidently be expected for teas of this class.—*Ibid.*

Tea in America.

The following is an extract from a letter from one of the leading tea brokers in New York:—

"In giving you such information as I possess relative to Indian teas in this country, I would say that of late there have been many efforts made to increase its consumption, and I believe these efforts have been to a certain limited extent successful. I say "successful" and yet "limited," because with the present taste of the American public, there would appear small hope of the distribution of the ordinary Indian black tea, say, Congou, Souchong, and Pekoe, ever being other than limited, its use probably being confined to mixing with low grade black China teas.

In taking up your questions as asked—1st, as to the best kind of teas to send, of course, this is the all-important question, and perhaps the answer that will convey the best idea to you will be to give you approximately our consumption of each kind.

Japan	estimated	roughly	at	34,000,000
Green	"	"	"	16,000,000
Formosa Oolong	"	"	"	10,000,000
Amoy & Foochow Oolong	"	"	"	6,000,0000
Congou	"	"	"	4,000,000

Now your Indian tea approximates most closely to Congou which has the smallest consumption of anything, and is indeed almost confined in its use to two or three of our large Eastern cities. You will note that Japan supplies about half our wants; it is *the* tea of the country, completely eclipsing Green, although in itself it is really nothing more nor less than a green tea. People have got the idea that it is uncoloured, I suppose; at all events, it is taken in all sections, and is increasing in popularity. Now the suggestion I have to make is this: The Japanese have endeavoured to manufacture a Congou that shall compete in the English market with China tea, and failed badly enough; but the tea they produced certainly approximated in many of its characteristics to an *Indian* tea—lighter and thinner in cup, but of similar character. Now, why should not Indian planters manufacture a tea that should compete favourably with Japan in this market? There must be similar properties in the leaf, and I would suggest that the experiment is worth trying. From the figures I send you to-day you will see we are heavily overstocked, but that need alarm no one; the surplus is all low grade leaf; choice is readily saleable at fair prices, so the time is by no means a bad one for trying it with *choice* teas. I may send you a sample of Japan to be matched, worth 46 cents; it will be necessary to bear in mind the necessity for a light coloured liquor, even at the expense of "body." As to the size of breaks, it might be well to begin with about 25 to 50 half-chests; if successful, these might be increased 150 to 200 half-chests. The packages should resemble the usual American order package weighing about 70 to 75lbs. gross, tare 15 to 17lbs., *papered*, *matted*, and *rattaned*: the expense will be refunded by extra price, but great care should be taken that they run of even weights, to save loss in taring.

Broken and dusty teas *are* objected to; 5 to 7 per cent. of dust, however, would not be objectionable. As to *black teas*, Formosas are the most popular; could you not imitate them closely? I am not well posted in their manufacture; but it would be easy to get at the method. I believe the leaf does not

undergo the *pressure* and consequent loss of moisture (? tannin) that Congous do. Avoid *thin* teas for these, a good pungent liquor is necessary. In case of tea transhipped at London from Calcutta to New York, if they are declared in the consular certificate to be for consumption in the United States, no duty is chargeable; if, however, they are offered in the London market and afterwards forwarded to New Yorker they become liable to the ad. val. 10 per cent.

For statistics, I enclose copy of printed market report, published to-day, with figures to 1st instant.

The demand now running on higher cost teas (except) Congous, which are almost without inquiry, would appear to favour a trial of *such* grades; there is little hope of your being able to compete with the Japans and Oolongs selling at 18 cents to 20 cents (9*d.* to 10*d.*) For a small quantity of choicest early Japan, I could pay to-day 48 cents to 50 cents (2*s.* to 2*s.* 1*d.*)—a fancy tea."

It is a fact worthy of the attention of Indian tea growers that 18 years ago the teas of Japan were scarcely known in the American market, and now the consumption of them amounts to upwards of 34,000,000lbs. annually. As Indian tea is intrinsically superior to Japan produce, the future of Indian tea in America ought to be undoubted, seeing that our cousins are cute enough to know a genuine article when they see it.—*Home and Colonial Mail.*

Consumption of Tea in America.

Now that it is in contemplation to try to open up trade in Indian tea with America, it may be of interest to our readers to learn that during the year ending 31st December 1880, the number of packages of tea distributed in America was 232,647. The figures showing its deliveries of tea in the United States for the past twelve months are as under:—

Greens.	Japans.	Oolongs.	Congous.	Total.
16.667,000	35,949,000	14,079,000	4,511,000	71,206,000

In 1879 the figures were as under:—

17,326,000	33,380,000	19,321,000	4.157,000	14,184.000

There has thus been a falling-off in the consumption of tea in America on the whole, although the trade in Japan shows an increase of 2.569,000lbs On the 22nd December a sale of 877 half-chests of Foochow tea took place, of the "Cheong Kee" class, for which the following prices were obtained:—

191	Finest	50 to 55 c.	equal	2 1 to 2	3½ a lb.
219	Extra fine	38 to 41	"	1 7 to 1	8½
291	Fine	28 to 28½	"	1 2 to 1	2½
176	Fully good	24 to 25	"	1 0 to 1	0½
877	Average	35½ c.	"	1 6	

The demand is noticeably for the better grades in all kinds.—*Ibid.*

Competition for the American Tea Trade.

The Japanese tea merchants are endeavouring to secure the American market for their tea. We read in the *Overland China Mail* that a number of Kobe merchants have formed a Company for the export of tea to the United States, and to despatch agents there to carry on an extensive business in that country. The question of combinations to defeat the object of all sales by auction is attracting the serious attention of auctioneers and the public generally in Yokohama.—*Ceylon Observer.*

State of the American Markets.

"The market is said to be panic-struck—cause not mentioned, but large quantities of teas are being pressed for sale at ruinous prices; for example a large parcel of tea shipped from here by the "City of Peking" in September, the cost of which, laid down at New York, was 29 cents. per lb., is valued now at only 16 cents. and not even sold at that. This untoward condition of affairs should convey a lesson to the 'direct shipping' enthusiasts, which they will do well to take to heart, and profit by accordingly. Let us take a month's business in teas by way of example. In the month of August last were bought about 10,000,000lbs., at such prices as show a present loss in the New York market of about 10 cents. per lb. all round, or, in other words, a single month's transactions stand, according to the very latest telegraphic advices, to lose a million dollars. This ugly fact should operate as a caution and a warning to those furthering 'direct shipment' projects. Are Japanese bankers and merchants prepared to face such losses as these in hard cash? Not in paper, be it remembered. Foreign capitalists have to face the situation and to drop their dollars with the best grace they may."—*Japan Herald.*

Report on the Canadian Tea Market—A New Market for Indian Tea.

Sir,—The tea planters of India are sufficiently alive to the necessity of opening up fresh markets for the produce of their gardens, but the persistence with which they adhere to the original method of making up all their tea on the model of China black teas, would almost leave it to be inferred that either they are wanting in enterprise to push their teas beyond the English market, or they know nothing of the state of the tea trade in the other great markets of the world.

Surely if it were known in India that of the sixty-three million pounds of tea imported into Canada in the first seven months of the current year, only about one-tenth was black

tea, and that the other nine-tenths consisted of Chinese green tea and natural leaf Japan tea, the planters would make some effort to adapt at least a portion of their output to this market, and to enter into competition for the supply of the United States,—the greatest tea consuming country in the world, and equally with Canada, a green-tea drinking country. A certain measure of satisfactory, and presumably permanent, trade in Indian teas has been created with England, but the demand is almost limited to Pekoes and the finer class of Pekoe Souchongs suitable for flavoring up Chinese Congous, which have had their Pekoe leaf carefully sorted out for Chinese home consumption ; but the grades of Indian teas below these qualities give no promise of growing into favor in England, while the very fine quality of the green teas manufactured in Upper India for the Central Asian trade, lead me to infer that the Indian leaf is especially adapted to the preparation of green teas, which even in the lower grades would command satisfactory prices on this side the Atlantic.

I have placed myself in personal communication with several of my acquaintances among the planters of Upper India on this subject, and having established an Agency in Montreal, have every facility for placing suitable Indian teas upon the Canadian market, and I hope to pave the way to a considerable development of the Indian tea trade in this direction ; being perfectly satisfied that if the Indian planter will give practical effect to my suggestion, there is an ample market for the whole Indian output on this side the Atlantic.

In the Canadian customs returns Japan and green teas are grouped together, so that it is impossible to determine the exact proportion of each ; but from my knowledge of the trade, I should say that the Japan teas constitute considerably more than half our total imports.

These Japan teas owe little to appearance : they have apparently been subjected but to little firing, and the leaf, which is in various shades of dull olive green, is not rolled up compactly, but just folded once upon itself as if sun-dried. The mode of preparation could probably be ascertained through the agency of our consuls, but the subject is of sufficient interest to Indian planters to warrant the deputation of a competent man to familiarise himself with the method of preparation.

Some few years since Japan shewed sufficient enterprise to make up a lot of Pekoe for this market in imitation of Indian Pekoes. These teas look well, are fully up to the standard for strength, but they are overfired, and want the aroma of the Assam Pekoe ; and failing to command good prices, are no more imported. This is an instructive lesson ; the same tea which, fired and got up as a Pekoe, scarcely saleable at sixteen pence in this market, is worth two shillings prepared as *natural leaf*, or *basket fired.*

The one lesson which I wish to convey to the Indian planter is, that here is a market large enough to absorb the whole Indian output, but that if India thinks seriously of competing for a share of the trade, she must adapt her teas to the market.

The Canadian demand for Indian Pekoes and Pekoe Souchongs is limited by the consumption of Congous ; the trade at present is small, but ruling prices are approximately ten per cent better than in England, and the trade is susceptible of some development.

The following are the current prices of teas in Montreal :—

Japans	...	1 0	to	2 2	}	English money.
Young Hyson	...	1 4	„	2 8	}	
Gunpowders	...	1 4	„	3 0	}	The bulk of business done is in the medium grades.
Imperials	...	1 4	„	2 8	}	
Congous	...	1 1	„	2 0	}	
Indian Pekoe	...	2 0	„	2 6		
Pekoe Souchongs	...	1 3	„	1 9		
Upper Indian Souchongs	...	1 3	„	1 6		

These prices include the duty paid, ten per cent. *ad valorem*, with an additional penny per lb. on black, and 1½ per pound on green teas.

I am, yours faithfully,
C. F. AMERY.
Tea Agency, 487, *St. Paul Street, Montreal.*

PART VII.—MISCELLANEOUS.

BRICK TEA.

I AM in a position to give information anent the making of brick tea, as at one time I went in largely for the manufacture of it.

I had the recipe from a Thibetan, and the tea I made was said to be very good by the Lepchas and Bhootias who tasted it.—in fact as good as the brick tea from China, of which I believe the Grand Llama of Thibet has the monopoly. I must own I never had the pluck to taste it myself.

The manufacture of this tea would be very profitable if it were not for some difficulty about the sale of it,—occasioned, I fancy, by the said monopoly of the Grand Llama. The bricks fetch about Rs. 4 a piece, and cost scarcely anything to make; but the trouble is in the selling. They cannot be sold wholesale, and even sold retail they have to be smuggled through some influential Llama or Mundle, who sells them for you under the pretence of their having come from China, &c., and of course expects a commission *almost* as large as a Calcutta broker would.

The following is the process, and I have explained the apparatus separately :—

1*st.*—It must be understood, brick tea is not made from the young leaves like ours, but from the old ones cut off in the pruning in the cold weather.

These leaves, stripped off the branches that have been pruned off, are *boiled* in a large cauldron in water passed through ashes, (keranee ka panee) until the water is nearly evaporated, and the leaves are in a glutinous state, which takes about an hour and a half.

2*nd.*—On being taken out of the cauldron they are beaten with a large wooden mallet, in a box made sufficiently strong for the purpose, until they are in a pulpy state.

3*rd.*—They are hammered into the mould with the mallet, and a little congee water from boiled rice, or starch, is mixed with them to help them to cake. Of course the leaves should be slightly above the mould when it is full, as the pressure put upon it soon brings the brick down to its proper size.

4*th.*—They are put into the press, and kept there for 24 hours. Of course the press is managed in such a way that any number of bricks can be put in at the same time, and those that are ready can be taken out without interfering with the rest.

5*th.*—On taking the bricks out of the press, they should not be taken out of the moulds at once, but left for 12 hours or so; and on being taken out they should be placed in a rack over a slow fire that they may *thoroughly dry*:—this is very important, or they will get mouldy.

6*th.*—They should then be stacked in a dry place, such as the loft of a drying godown, and should be occasionally looked to, and wiped, if any signs of mildew are observable on them.

This is the whole process of manufacture. The apparatus required is—

1*st.*—The cauldron,—a copper "dekchee." The largest procurable is the best.

2*nd.*—A stoutly made box and mallet.

3*rd.*—The moulds, 15 inches long by 9 inches broad, by 6 inches deep. These should be dove-tailed with a pin to go through the corners, so that they can be opened out and put together again without injury to them or their contents.

4*th.*—The Press. The best kind to use is a beam about 20 feet long, fixed at one end on an axle, and weighted at the other end. Any amount of pressure can be put on by this means, and it is preferable to a screw, as it is a continual pressure.

J. P. B.

PRODUCTION OF BRICK TEA IN HANKOW.

THE Commissioner of Customs at Hankow reports that the importance of the brick tea trade is rapidly increasing, and the demand becoming greater than the supply. The employment of steam machinery for pressing the bricks has proved in every way a great success, the steam-pressed brick being much better finished than that produced by hand, and more compact and firm, withstanding the difficulties of transit better, and ultimately arriving at its destination in Siberia little, if any, the worse for its journey. With the old method, the bricks, from insufficient pressing power, were liable to chip and crumble at the edges; and as great stress is laid on the perfect appearance of the brick by the Siberians, it can be easily understood that a hard, sharply defined brick would at once obtain the preference. With both methods of manufacturing brick tea there is a drawback, and a serious one—the damping of the dust by steam, which robs it of all its fragrance. To remedy this defect a firm has imported an hydraulic press, which turns out small corrugated-shaped cakes, weighing a

quarter of a pound each, retaining the original aroma in all its freshness. There has not, says the Commissioner, been sufficient time yet to ascertain whether the compressed tea will prove a success or not, but samples sent to Siberia have been favourably reported on; and as the improvement of the ordinary brick was so quickly recognised, it is expected that similar popularity will attend the latest experiments. The two kinds will probably run side by side in friendly competition, as the brick will keep its own position for use among the masses, and the compressed tea will become popular amongst the better classes, and if really fine dust be employed in its manufacture it may, from its portableness and cheapness, generally take the place of the leaf tea at present annually sent overland from Shansi. The following is the method of producing the brick tea. There are at present six manufactories in Hankow, in three of which boilers are used either for steaming the tea, or both for that purpose and furnishing power for pressing. The dust from which brick tea, is made comes principally from Ningchow in Kiangsi, and Tsung-yang and Yang-lout'ung in Hupeh, and varies both in fineness and cost, according as it belongs to the first, second, or third crop. From four to ten taels is the average cost. The first operation is to sift the dust and reject all the sand and rubbish contained in it, usually amounting to about five per cent. It is then placed in a winnowing machine having three different sized sieves, with troughs corresponding, and passed into baskets. The residue which is too coarse to pass any of the sieves is taken out and trodden until it is reduced to the proper consistency, when it is placed in iron pans over a charcoal fire until it is sufficiently brittle when it is again taken to be winnowed, and this operation is repeated until it has all been sifted to the requisite degree of fineness. Three sizes are produced, the coarser ones being employed to constitute the brick, while the finest dust is only used as a facing. The dust having been properly sifted, the next step is to prepare it for pressing, and this is done by exposing it to the action of steam for three minutes, and it is this steaming that robs brick tea of its scent and flavour, and for which a remedy is eagerly sought. The old-fashioned apparatus of native design consists of six iron boilers heated by charcoal, and having spaces over, which are fitted with rattan covers. When the dust is to be steamed, it is spread out on a sheet of cotton cloth placed over the boiler and covered up; but with the improved European apparatus the dust is simply put into iron boxes and the steam then passed through them. After having been sufficiently steamed to make it adhesive, the dust is put into a strong wooden mould, on the moveable cover of which the trade mark of the "hong" or firm is engraved, (so as to leave the corresponding impression on the brick) and firmly wedged down. It is then pressed and placed on one side for two or three hours to cool. Each brick should weigh one catty, and all those that do not come up to the proper standard of weight, or are defective in any way, are rejected and re-made. For this purpose they are taken to a rotatory mill, constructed of two heavy circular stones, moved by a horizontal wooden bar, and working in a channel where the condemned bricks are thrown, and crushed as the wheels pass over them. Having again become dust, the operation already described is, in all its details, repeated. The hand press turns out sixty baskets a day, with 25 per cent. failure bricks, while the steam press produces eighty baskets a day, with only 5 per cent. of bad work, and the saving, by the employment of the improved machinery, amounts to one tael a basket, or, according to the above stated out-turn, eighty taels a day, or about £20 sterling. The bricks found to be correct in weight and free from defects are stored in the drying-room for a week, when they are carefully wrapped separately in paper, and packed in bamboo baskets containing sixty-four bricks each. Green brick tea is made in the same manner, but of leaf, not dust, and the bricks are larger, weighing two pounds and a half each, thirty-six going to a basket when packed for export. During the past year only two factories in the interior, at Tsung-yang and Yang-lout'ung, were kept working, and it is expected that in a short time the whole trade will be transferred to Hankow to the benefit of its position as a commercial centre, and to the general interest of those connected with it. In addition to brick tea proper, there is also another kind of tea called "medicine tea," which is composed of coarse leaf and stalks, mixed with various kinds of medicinal herbs, and packed in bundles weighing sixty-four catties. It is valued at five taels per picul, and in the event of the cost of transhipment to Central Asia *vid* Tientsin, instead of as hitherto from Shansi,

proving sufficiently low, it is expected that the trade will receive increased attention.

Owing to the immense quantities of brick tea now arriving at Tientsin for transport overland, it is both more difficult and more expensive to obtain sufficient camels than it was a year ago, and it is anticipated that the sea and river route *viâ* Tientsin and the Amoor will soon be substituted as a necessary consequence of the growing magnitude of the trade.—*The Planter's Gazette.*

Compressed Tea.

Compressed tea might be made in this way:—Fill a box, with a perforated bottom, with properly withered good tea leaves, and force the sap out of them by hydraulic pressure, into a receiver below the box in which the leaves are pressed; then take the sapless leaves from the box and mix them in the juice, till it is all absorbed by or fixed on them; the leaves thus smeared with the juice would then be fermented or allowed to colour, dried in the usual manner, and afterwards be put into marketable shape by hydraulic pressure.

A Field for Brick Tea for Thibet from Darjeeling.

A good field for Darjeeling tea will be found to exist in an active competition with China for the supply of Thibet. At present China brick tea is mainly imported over the northern boundaries of Thibet, and fetches a high price. The distance, however, by the Darjeeling-Thibet road is not only less, but the road easier.

Creamy Indian Tea:

An Inquiry as to the cause of Change of Colour in Liquid Tea.

A little controversy has lately arisen with respect to the "wholesomeness or otherwise" of the gummy, gaseous-looking coat of film that settles and floats on the top of Indian tea. When scalded and infused in the cup before tasting or drinking it is hardly discernible; but as soon as the liquor cools the opaque coating begins to form, and some parties affect to be greatly concerned as to what the results might be to themselves and others if an authoritative opinion were to be pronounced upon the matter in dispute. Happily, the whole question is involved in doubt as to whether the gumminess detected in the liquor of Indian teas is a recommendation or not, some experienced tasters and valuers declaring in favour of teas which possess that peculiarity while other equally good judges regard the creaming of the surface of tea when not hot as a proof that the article is not pure. In this pleasant dilemma nobody's tender susceptibilities can possibly be hurt, as nothing definite is known of what are the true and undoubted characteristics of wholesome Indian tea, and no one's pocket or reputation is likely to suffer pending the settlement of so important an inquiry. It is, however, worthy of observation that the discovery, though not of very recent date, has only just excited a more than usual degree of curiosity, and to those who have not particularly noticed this new phenomenon of the tea-pot, we will briefly describe its appearance.

Those of our readers who will test the truth of the statement for themselves, that there is a slight gummy or oily substance contained in Indian teas, especially of the better class, will observe, on liquoring them, that, as the solution is allowed to cool, it forms a thin layer of dull whity-brownish matter, more dense than the liquor itself, at the top of the cup or saucer, and changes to a darker colour the longer it is left to stand. Reverse the process from cold to heat, and the creaminess, so-called (which, by the way, it must be understood, has been produced by nothing in the shape of sugar or milk being added to the liquor), will gradually disappear as it melts into the hotter liquid in which it was first placed. This conversion from one state to another proves that a kind of vegetable gum exists in the tea, which is soluble exactly in proportion to the amount of heat applied to or kept in the infusion. This, so far, is an ascertainable fact; the rest, which follows in the absence of better and more conclusive information, is mere conjecture, and must remain so until experts in tea-tasting finally agree which of the two kinds of liquors—the thick and gummy, or the clear and colourless—are the best for human consumption. The chief and, at present, only lucid explanation of this difference between one class of Indian teas and another is that the method employed in "curing" teas varies greatly in the two countries—India and China. In the former place the teas are only partially "fired," the young leaves, so full of moisture, not being heated above a certain temperature, thus leaving in them minute damp particles, which contain traces of gum or some unknown vegetable. With the Chinese the process

to burn or dry the teas as much as possible without positively injuring them, so as to deprive them of every trace of limpness, and render them crisp, brittle, and almost cindery. According to this description the two stages of preparation in one country and the other differ rather widely and are quite sufficient to account for the cloudiness in Indian teas and the brightness in those of China growth.

Having compared the two systems thus far, and shown that the different liquorings of tea are the result of opposite modes of treatment in drying the freshly plucked leaves, the question naturally arises, which is the best and most proper method of preparation, and that most conducive to the health and comfort of the consumer? People often complain of headache, indigestion, lassitude, &c., and from what we know and have been taught to believe of tea, it would be somewhat of a libel to charge that favourite, soothing beverage with causing any of the above "ills that flesh is heir to"; and yet, when we hear of teas differing so much from each other in colour, quality, and taste, and are convinced that *all* kinds, or *both* Indian and China grades, cannot be equally good, refreshing, and beneficial, we are inclined to think that "something must be wrong somewhere." In the absence of trustworthy experiments undertaken for the special purpose of determining which is the tea *par excellence*—China or India—we are loth to give an opinion on either side, though some persons of influence in the trade would decide the question entirely apart from its merits as regards the *tea* itself, and would pronounce off hand in favour of the country which had prepared tea for the longest period in history. This we are well aware is China, whose people began "making tea" about two thousand years ago, and certainly ought to know "how to do it" by this time. If not, they must be looked upon as a set of blockheads or wilful cheats; and it is because we do not think that they are either, that we hesitate to utter a word against them, presuming that everyone is commendable and honest until they are proved beyond all doubt to be the contrary.—*The Grocer.*

OUR contemporary the *Grocer* discusses the question whether the thickness of the cold infusion of pure Indian teas and the gummy gaseous-looking film which settles and floats on the top of the cup is wholesome or not. We invite our Indian readers to favour us with their views on this technical point. Our own idea is that, as by the admission of the writer of the article the appearance in question is noticed in teas "especially of the better class," that it is simply a proof that such teas possess more quality than those which do not cream over. The theory that the peculiarity in question is due to a defect in the method of curing, and that the teas of India which have the cloudiness referred to are only partially fired, while those of China are bright owing to their being properly fired, cannot be accepted as an adequate explanation unless we allow that the trade and the brokers do not understand the merits of tea. It was well known that teas which cloud when cold are invariably those of a high character, such as the D. F. B. in a triangle teas from Darjeeling, which have lately been keenly competed for, realising extreme rates.

If China teas seldom or never have the peculiarity above noted, the explanation is not far to seek. China never sends us her best teas.

With regard to the assertion that the writer hesitates to look upon the Chinese as "blockheads or wilful cheats" until they are proved to be so, we would only refer him to the repeated and continuous attempt on the part of some Chinese tea men to palm off on the Western Barbarian stuff which could not, even by courtesy, be called tea, but which is certainly remarkable for the absence of that creamy appearance which the writer seems to object to. —*Home & Colonial Mail.*

HAVING read your remarks under the head of "'Creamy' Indian Teas," the tendency of which appears to me to hint at a defect in manufacture as the cause of the "creaminess" in our Indian teas, I should like, with your permission, to offer a few remarks on the subject as an old tea-maker in India.

You remark truly enough that the "creamy," "gummy," or "oily" substance is observable in Indian teas, "especially of the better class." It is, in fact, a sure sign of the superior quality of the tea, and is not to be found in the lower grades of Indian teas any more than in the common China teas. If you would observe the result of letting a good China Pekoe cool, if it were a high-class tea, you would find a slight creamy film over it.

It is well known in the trade that a tea which gets cloudy on cooling is worth more than a thin tea which will not do so. China does not send us her fine teas, and I suspect that some of those she thinks good enough

for barbarians have already done service in in the land of their growth.

AN INDIAN PLANTER.

—*Home & Colonial Mail.*

AT the present time, when there is such a remarkable outburst of private and personal energy in the endeavour to popularise the use of Indian tea among the English people, it is worth while to notice an accusation made against the Indian leaf. It is asserted that a "gummy, gaseous-looking coat of film" settles and floats on the top of an infusion of Indian tea, most visible when the liquor cools. Those whose prejudice is easily alarmed profess apprehension of the wholesomeness of this appearance, although a good many professional tasters declare in favour of the quality of the teas which produce it, and value them at the best rates. When a solution of Indian tea is allowed to become absolutely cold, "a thin layer of dull, whity-brownish matter, more dense than the liquor itself," is formed at the top of the vessel, and changes to a darker colour the longer it is left to stand. It disappears on the re-application of heat. Hence it is supposed to be a vegetable gum existing in the tea. Experts in China tea aver that this fault in Indian tea is due to the method of curing the leaf. In India, it is alleged, teas are only partially "fired." The young leaves, full of moisture, not being heated above a certain temperature, are left with minute particles which contain the offending gum. The China tea, on the other hand, is dried as much as possible without positively injuring the leaf, and every trace of limpness is removed, leaving the leaf crisp and brittle. As the "cloudiness, to which reference is made, unquestionably hinders the popular use of Indian tea, the matter is well worth attention on the part of growers and curers."— *Times of India.*

WE planters are very glad that this subject is brought before the public; this gumminess is a point on which Indian tea ought to be congratulated, and particularly sought after by the brokers who, if they find that our teas are thin in the cup, give us less price. It merely shows that the Indian tree (this is mostly to be seen in Hybrid tea) is of a richer nature than the China plant, and has nothing to do with the curing; or perhaps the Chinese have had the first drink. If the writer had understood a little chemistry, he would have written better on the subject, and in praise instead of depreciation. Tea, if the fermentation is continued long enough, will become sour, or vinegar: this shows the peculiar vitality of the plant: vinegar comes from alcohol *only*, alcohol comes from grape sugar, and grape sugar from gum or starch. The Chinese destroy this gum by over-fermentation, and particularly when they carry the leaf for two or three days in a bag before they sell it. Even China tea leaf has this gum, but in a smaller proportion than the Indian leaf; either it is the nature of the soil or the climate that gives it. The Java planter, in his hand-book, particularly gives instruction to choose sweet soil, therefore this must be the soil which will introduce gum into the plant; and the Java planter takes his instruction from the Chinese, so what will the experts now have to say on the subject "merely to proclaim their own ignorance." "The young leaves full of moisture not being heated above a certain temperature, are left with minute particles which contain the offending gum; high temperature will not destroy gum; a large quantity of beautiful hard dry glue (animal gum) comes from China, which must evidently have been dried at great heat to remain in such large pieces and not affected by the damp air of India: so here is China gum not destroyed by heat. Indian tea is, I believe, dried at a higher temperature than China tea. To dry in $1\frac{1}{4}$ hours requires a temperature of 220°: this is over the heat of boiling water. Some planters dry quicker, therefore the heat is greater (perhaps 250°) in 40 minutes: this is called high fired tea. No China tea comes under this denomination,—showing the converse of what is sought to be proved. No tea is as a rule packed in India unless it is crisp and will break readily between the finger and thumb. Our teas are spoilt by the system of bulking in England, but the experts in China tea have not found that this system of bulking adds this gum to the leaf: a very curious fact.

I must refer the writer of this article to *Punch*, who has a cartoon on the manner of making new Port Wine into old. The gent requires a "holder and a thinner wine" and the waiter very simply carries the decanter of good rich Port Wine to the pump: hence a good result. I am afraid much of the China tea has been infused (the lightest manner of speaking of it) before it reaches England.

S.

THERE is some correspondence going on at present about the gummy (?) appearance of some Indian teas when allowed to cool.—

some people being under the impression that the peculiarity is in the leaf, and some that it comes from the soil.

The truth is that it is simply the effect of over-fermentation, as I have often proved for myself; and the way to test it in a warm state is to compare the liquor in a glass with that of an under fermented tea, when the former will have a dull and the latter a bright clear appearance.

The over-fermented liquor will become quite opaque if allowed to cool.

The cause of the discoloration, I think, is the presence of saccharine matter.

Liquors of burnt teas have the appearance *at the top* of an oily substance, which is the essential oil I believe, but it is quite different from the thick appearance of the over-fermented liquor, which is *throughout.*

THE cause of some samples of Assam and Cachar tea, after the liquors are first poured out, being of a bright color; but the same liquor if allowed to get quite cold, having an appearance as if a muddy creamy liquor had been added, which becomes bright again if heated, is owing to difference in fermentation.

The "muddy creamy color" is seen in "malty teas" or teas that have been *allowed* to ferment, while those liquors which remain clear when cold, come from fine " pungent" teas, *i e.*, those in which the fermentation has been *driven* off.

COMPARISON OF TEA YIELD IN INDIA.

IN working out the yield per acre of the tea plantations noted in the statement of Outturn, &c., published in your issue of 20th July, I have been surprised to find the results so nearly similar in each locality.

The highest yield per acre in 1876 for Darjeeling was 270lbs., Assam 333lbs., Cachar 330lbs., Kangra Valley 246lbs.

The plantations from which these results have been obtained are, I suspect, those in which there is least land lately brought under tea, and that the column "Acreage under Cultivation," represents pretty accurately in their case, the land giving a fair yield of leaf all over.

Taking as a base for calculation the distance of the bushes apart to be that usually adopted in the district in which I reside, *viz.*, 4 ft. × 3 ft., this will give Darjeeling 1·18oz., Assam 1·46oz., Cachar 1·44oz., Kangra Valley 1·08oz. tea per bush per year—a very small quantity, it appears to me, if as I opine these plantations have been carefully tended during the past ten years.

Let me now give you a description of my plantation, and the results I have obtained under very adverse circumstances.

First, in my ignorance of everything connected with the business I was about to undertake, I bought, in 1875, some 40 acres of gravel hills, on a portion of which there were 26·832 bushes of 1867; and 10,284 of 1872 and 2,262 of 1873, which had yielded 580lbs. tea to the former owner in 1874.

As I commenced operations in February 1875, the season for winter cultivation by hoeing and manuring had passed, and I could only manage to give the land a light hoeing, and prune out some of the hard white wood before the leaf came on. During the rains they had three light hoeings to keep down the weeds, and such small quantity of manure as I was able to obtain, which was about 2 tons per acre.

May and June of this year (1875) were very hot months, during which I only made 41lbs. tea, and the bushes were so scorched that I greatly feared this to be the last outturn I should get from them. With the rains they revived, and by the end of the season I made 1,750lbs., and had by careful plucking, allowed my bushes to increase greatly in size. By careful plucking I mean that I avoided taking off "*flushes,*" and kept my pluckers continually gathering in only such leaf as was fully ready. Of these, 1,750lbs. 2 per cent. was Congou, and 1 per cent. Bohea.

During the cold weather of 1875-76 deep hoeing, taking huge Mizpah stones and Jacob's pillows from amongst the roots, and applying manure according to the size of the bushes at 12 to 15 tons per acre, was the order of the day. A large quantity of white wood and crow's-feet were cut out, and three light hoeings given during the rains. The plucking was done in the same manner as in the previous year, and the outturn was 2,335lbs., with the same percentage of Congou and Bohea as before.

In the cold season of 1876-77 the whole place received a thorough deep hoeing, more old white wood and crow's-feet pruned out, and in the early spring a troop of

youngsters put to taking off every flower-bud. My outturn from these bushes up to the end of May for this year has been 1,843lbs., with 3 per cent. Congou and Bohea, so that my estimated outturn for 1877 should be 1843 × 3=5,529lbs.

Supposing my garden to be planted out 4 × 3, my 39,378 bushes would be 10·8 acres, and the outturn per acre 512lbs.—if I realize the estimated 5,529lbs., *i.e.*, 2·25 oz. per bush.

Some of your readers may exclaim, "Oh yes! all very well, but only 10·8 acres had to be looked after." To such I would say please note that the Dehra Doon Tea Company has 351 acres under cultivation, and its actual outturn for 1876 was 197,210lbs., giving 562lbs. per acre. At the same time I must confess that, while quoting this plantation as an example of good yield, I do not know at what distance apart its bushes are planted out. If at 4 × 3, then the yield is 2·47 oz. of tea per bush per annum. This is a good, but not a wonderful, outturn; my next door neighbour has, to my certain knowledge, obtained over 3 oz. per bush.

PE-KO-SOU-CHONG.

Kangra Valley.

YOUR correspondent "Pe-ko-Sou-chong" has, it appears to me, made a slight mistake in his calculation respecting the highest yield of tea for 1876,—270lbs. per acre for Darjeeling; it should have been 370lbs.; the Singel Estate is quoted 375lbs. per acre, but this does not give a true idea of the possible yield of the Darjeeling hills. It may be the highest yield for ordinary (as it is called in England) *field cultivation*, but no idea from that can be obtained of garden cultivation, from well-filled-up land. Your correspondent, when mentioning the yield, should also state whether it is the result of low farming (as it is called in England), and what kind of farming is carried on at the Dehra Doon Company. Perhaps some other Darjeelingite can come forward and top the 370lbs. per acre. That we may have a correct idea of the proper yield of an Estate is very important. Besides making some of the finest tea in the world, we in Darjeeling can make it in quantity. Here is the yield of two of my small gardens—

One of 34 acres in 1875 gave 384 mds } about
The other 25 " " " 265 " }

11 maunds per acre. In 1876, these gardens gave 10 maunds per acre; but I have another garden, 980 acres, which gave less (5 maunds per acre). This reduces the average much. However, in 1876, 143 acres old and 30 acres young plant gave 1,161 maunds, or 530lbs. an acre. That properly cultivated, well filled up and manured land, can yield very largely there is no doubt. In Assam, I believe, it has given 17 to 19 maunds per acre, and the highest yield in Darjeeling from a small area (5 acres) of land, yielded this year at the second flush at *one pluck* (there are at least 12 plucks in the season) 1,050lbs.: this is 210lbs. per acre. The great thing is to make all the plucks yield like this one. A careless day's pruning or plucking lessens the average, sometimes as much as 25 per cent. for the next yield.

DARJEELING PLANTER.

YOUR correspondent "Pe-ko-Sou-chong," from the Kangra Valley, says that, having worked out the yield of tea per acre in 1876, he finds that the highest yield in the Darjeeling district was 270lbs. In reality Darjeeling can claim to stand much better than this, for the outturn of the Dooteriah Garden, which consists of about 600 acres, is believed to have been within a very few maunds of 3,000; and on a garden at Hope Town 1,100 maunds are understood to have been made off a plucking area of about 170 acres, which gives, say, 400lbs. per acre in the first, and considerably over 500lbs. in the second case. And one of the Terai gardens is well known to have given over 650lbs. per acre,—1,000 maunds having been manufactured from 122 acres.

AH CHA.

SOME of our correspondents seem to think 6 maunds a good yield per acre, but we know of a factory in Upper Assam which yielded last year (1876) 11½ maunds, per acre, and others in the same district which yielded 10 and 8 maunds.

I DO not see why 1,000lbs. of tea should not be the average arrived at per acre. When one comes to look at it, it is only 4,000lbs. of green leaf per acre. True, it represents the young sprouting leaf, still I don't think it is too much. One bush of indigenous—or almost pure—was fenced off, and plucked separately. It was not otherwise attended to specially, and it produced 13¾ oz. of made tea. With similar bushes planted 5″ × 5′, this represents 1,500lbs. per acre. As this bush was not specially treated, I do not

see why 1,000lbs. per acre should not be made with ordinary care.

MAC.

MY leaf season having ended, I now send you a comparative statement of leaf yields on my gardens, from which will be seen the increase of yield obtained by me from the same plots containing the same bushes only.

Garden A claims special notice, as its bushes were planted out—plots 1 to 6 in 1867, and 7 to 9 in 1872; and the difference of yield in 1879 and 1880 cannot be attributed to difference of age of the various plots. In 1875 this garden only gave 6,960lbs. leaf, so that in four years its increase was 136°/o, and in five years 239°/o, with mature but neglected bushes on which to commence operation, and they have not not yet, I believe, attained their maximum yield. Wind and weather permitting I intend they shall do better in 1881.

Gardens B, C, and D have been planted out by me in and since 1875. The underlined figures in Column TEA PER ACRE has been calculated at 8,712 bushes per acre; these plots having been planted out in double hedge-row in the manner I previously explained to you. All the rest have been taken as 3,630 bushes per acre.

That my bushes have not been robbed, will be evident from the fact of the great increase of yield attained each year; neither can my results be said to be caused by more favorable weather conditions over other plantations, for if they have had cause to complain of droughty seasons, so much the more have I, as my gardens lie outside the line of heavy rainfall in which most of the other plantations are situated nearer the base of the mountains.

To what causes, then, can these—in point of *weight*—superior yields be referred. For the present I leave directors, shareholders, and managers to draw their own inferences, and frame their own conclusions, and will only add as my opinion that almost any piece of land in the valley can, with a liberal but not extravagant expenditure, be brought to do the same.

As my critics may ask what meaning I apply to the term "liberal," I will tell them before they ask, *viz.*, any amount that will ensure their crop being worth double its working expenses; and this really can only be judged by him who actually conducts the various operations of cultivation, and who alone can know the actual requirements of his bushes in each locality.

COMPARATIVE STATEMENT OF LEAF YIELDS, 1879 & 1880.

Plot No.	Garden A. Leaf 1879.	Garden A. Leaf 1880.	1880.	1880. Tea per Acre.	Garden B. Leaf 1879.	Garden B. Leaf 1880.	1880.	1880. Tea per Acre.	Garden C. Leaf. 1879.	Garden C. Leaf. 1880.	1880.	1880. Tea per Acre.	Garden D. Leaf 1879.	Garden D. Leaf 1880.	1880.	1880. Tea per Acre.
1	1,034	1,344	310	542	581	1,489	908	730	958	1,920	962	369	539	720	181	325
2	579	894	315	422	282	631	349	631	1,898	2,866	968	362	431	670	239	251
3	1,525	2,369	844	485	151	244	92	407	1,269	2,216	947	410	518	726	208	378
4	1,278	1,827	549	692	169	557	388	516	39	131	92	...	128	74	54	...
5	6,752	9,286	2,534	616	111	386	275	283	...	...	...	...	131	317	186	...
6	1,363	2,146	783	447	..	73	72	...	...	...	...	...	...	...	...	...
7	1,411	2,418	1,007	512	...	45	45	...	...	...	...	...	...	...	...	...
8	1,116	1,178	62	508	...	...	...	...	...	...	...	...	...	...	...	...
9	1,407	2,188	781	516	...	...	...	...	...	...	...	...	...	...	...	...
13	...	...	...	Aver-	62	994	932	Aver-	...	...	...	Aver-	...	...	...	Aver-
14	...	...	...	age	...	59	59	age	...	...	...	age	...	...	...	age
	16,465	23,650	7,185	526¾	1,357	4,477	3,120	513¾	4,164	7,133	2,969	380½	1,747	2,507	760	318

Kangra. CEPHAS.

A CORRESPONDENT, writing from Kangra, says that the average outturn per acre of native gardens in that district is about double what is given in the official returns. It suits the natives, apparently, to represent themselves as poor men. They do not cultivate properly, but they get an immense amount of coarse leaf, which they say is admirably suited for green tea; and they obtain about Rs. 2-4 per "batti" (2 seers 4lbs.) or 9 annas per lb. on the spot, free of packing or other expenses Our correspondent is of opinion that, if the natives choose to exert themselves, they might make much more.

The area of cultivation in Kangra under native management is given in the latest Government Report as 2,100 acres, but our correspondent is of opinion that it is considerably more than this, and it is being continually increased.

Yield.—How much has been written on this point, and yet how little we know about it! A few tables from mature gardens stating the elevation, would help us greatly. The garden from which the figures below are taken is "Phool" (short for Phoolbarree), and on that the Leesh Company's gardens, and "Gundha Bheel," all in my charge, I expect eventually 10 maunds tea per acre. These three plantations are close together in the "Western Dooars," and I thought years ago, when I first began work there, and the place was a howling wilderness, that the said "Western Dooars" would eventually prove the best tea district in India. I think so more than ever now, and many others to-day think with me. The table I give below shows what has been done already at "Phool," (the other gardens are yet quite young) and it justifies, I think, my anticipations.

The present average yield of *good* mature plantations in India, I take to be (about) *Hill* (elevated) 3 to 4 maunds, *Plains* 5 to 6 maunds per acre, though the yield of *all* the tea cultivation (mature) throughout India does certainly not average even 4 maunds. This will *not* be so a few years hence, for firstly, our knowledge of how to obtain large yields will increase, and secondly, at the present range of prices and any future possible, if even better ones, some gardens cannot last. Ten maunds an acre sounds unlikely, but I believe some plantations, with indigenous plant, will do even more than this. My gardens are not indigenous, but high class hybrid, and I, therefore, limit my yield to 10 maunds.

Another practically interesting point to solve would be the duration of the picking season. Of course, elevation barred, and other things being equal, the lower the latitude the longer it is. In Chittagong, for example, I used to pick up to Xmas day. In the Western Dooars, the end of November is the limit. Elevation, of course, decreases the period, and equally of course, on account of latitude, the "Darjeeling" gardens continue perhaps a fortnight after the "Kumaon" plantations have ceased. I would suggest that in any tables such as I give being sent you, the commencing and finishing picking dates be given.

The "Phool" garden, to which the table below applies, is 304 acres. It is all in one continuous block, divided into five acre sections on flat land, so there is no difficulty in calculating the area. It was planted as follows:—

Year planted.	*Area in acres.*	*Age in 1880.*
1875	40	5 years.
1876	27	4 ,,
1877	196	3 ,,
1878	41	2 ,,

Total area ... 304 acres.

The vacancies do not exceed 3 per cent. No planting has been done since 1878, and that was the first year any appreciable amount of tea was made.

The following is the tea made each month in the three years—showing also a comparison each year to end of August and a comparison of the yearly totals:—

Months.	1878. M.	1878. lbs.	1879. M.	1879. lbs.	1880. M.	1880. lbs.	
February	0	0	0	0	0	51	These have been made in 1880.
March	3	18	11	70	42	65	
April	6	62	15	34	67	18	
May	22	1	76	51	87	2	
June	25	70	71	51	173	33	
July	32	59	102	45	244	38	
August	35	76	134	33	201	65	
September	32	45	121	57	245	0 ?	These are estimated amount for 1880.
October	46	73	108	76	217	0 ?	
November	17	7	42	15	84	0 ?	
December	0	0	3	47	7	9 ?	
F. and extract season ...	106	9	27	7	30	0 ?	
Totals to end of August ...	126	46	412	44	817	37	Actually made 180.
Totals in whole year ...	234	0	716	6	1400	37	? Estimated amount 180.

This table is suggestive in the following particulars: To end of August 1880, the figures given have been carried out. For the latter months they are estimated, and I put a ? to each to show this. Supposing they are nearly right, and I know they must be so, the yield for 1880 will be 1,400 maunds or very nearly double of 1879. However, at end of 1880, I will send you the exact figures.

The year 1880 has been a very good season as regards weather, and on that account, perhaps, 100 maunds should be deducted; but, on the other hand, I lost at least 100 maunds by red spider in April and May, so, setting one against the other, 1,400 maunds may be considered average figures for the purposes I am considering.

The age of the different areas in the "Phool" garden is given above, and supposing 1,400 maunds to be about the true yield for this year, then I calculate the areas of different ages have given about as follows:—

				Mds.
41 acres	2 years old at	2 mds per acre	=	82
196 „	3 years	4 „ „	=	784
27 „	4 „	6½ „ „	=	175½
40 „	5 „	9 „ „	=	360
			Mds.	1,401½

and, I think, all the above bears out my expectation of an eventual yield of 10 maunds per acre.

I think 6 years in a climate like the "Western Dooars," may be put down as maturity for tea plant, if well cultivated up to that time, and I shall certainly be surprised if, in the year 1884, "Phool" does not give me 3,000 maunds of tea.

The same with the "Leesh Tea Company" gardens and "Gundha Bheel," for these two will each be made 300 acres and no more, and should, when at maturity, give the same return. They are like Phool in all respects.

I said years ago, that 10 maunds per acre would not eventually be considered a wonderful yield. This and other opinions I expressed about tea were looked on then as visionary*, but I think I was right in each: at least I hope to show 10 maunds in Western Dooars.

One thing, though I never foresaw, and that was the present low prices. I think, if I had, I should have dropped tea when I sold my Chittagong garden. For except with a large yield, or making exceptionally flavoury teas, as some of the elevated gardens do, success cannot be looked for in the future.

E. M.

* Among others I may instance firing tea without charcoal, but that is now a great fact.

CONSUMPTION OF TEA IN ENGLAND AND CHINA.

In England.

The following table gives the Consumption of Tea per head of the population, from 1840 *to* 1877:—

Year ending Mar. 31.	Consumption of Tea.	Year ending Mar. 31.	Consumption of Tea.	Year ending Mar. 31.	Consumption of Tea.
	lb.		lb.		lb.
1840	1·22	1853	2·14	1866	3·42
1841	1·37	1854	2·24	1867	3·68
1842	1·38	1855	2·23	1868	3·52
1843	1·48	1856	2·26	1869	3·63
1844	1·50	1857	2·45	1870	3·81
1845	1·59	1858	2·58	1871	3·92
1846	1·67	1859	2·67	1872	4·01
1847	1·66	1860	2·67	1873	4·11
1848	1·75	1861	2·69	1874	4·23
1849	1·81	1862	2·70	1875	4·44
1850	1·86	1863	2·90	1876	4·50
1851	1·97	1864	3·00	1877	4·50
1852	1·99	1865	3·29		

Since this period, the ratio of consumption has been a yearly increasing one, till it now reaches probably 6·50; but in Australia the calculation is high as 10·50.

Consumption of Tea in China.

"We have no very certain means of estimating the quantity of tea consumed in China, but we may nevertheless draw conclusions from such data as we possess. Taking the population of the country, then, at 400 millions, and considering that the use of tea is universal amongst them; that they drink it from early morning until they retire for the night; that, in sickness or health, working or resting, travelling or at home, it is the one great national beverage, without which no Chinese family could live and thrive;—considering all this, I think I am not overrating it when I set it down at an average of 5lbs. a head per annum, or a total of 2,000 millions of pounds! Others estimate it much lower—Scherzer at 400 millions; Andrie at 500 millions. Now if we allow 100lbs. of cured tea as the average produce per acre in China, this will show a cultivation of 20 million acres in tea alone, whereas I am more inclined to estimate it at 25 million acres. Just let us compare this with other cultures in other countries. France, which is not larger than one of the Chinese provinces, and contains less than one-twelfth the population of China, has nevertheless, five million acres in vines. The

Southern States of America have seven million acres in cotton, cultivated by less than one and a half million of Negroes; and India, with only half the population of China, has 14 millions of acres in cotton. These comparisons are quite sufficient, I think, to prove that there is no improbability attached to the estimate I have given of the extent of land devoted to tea culture in China. I therefore leave out of the question the area occupied in different countries by such crops as rice, wheat, &c.

"If we allow that the internal consumption of tea in China amounts to 2,000 million pounds, we cannot but be struck at the comparatively small quantity she exports; for, according to the latest statistics, we find that her total export of tea to all countries does not reach 200 million pounds, being less than one-tenth of her own consumption. Of this quantity the United Kingdom took about 78 million pounds in 1860."—*Mr. L. Wray's Paper read before the Society of Arts in* 1861.

The "Tea of the Future."

"While commercial matters in the City cannot be said to be overflourishing, the tea market has taken a turn to the good with the opening of the new year. A very important item has to be chronicled in connection with this, namely, the rapid favour into which Indian teas have grown. Good judges and observers of the barometer of Mincing Lane declare that so great has been the increase in the quantity imported that with similar progress we may in a few years become almost independent of the China leaf. A new field for tea growing is also being opened up successfully in Ceylon, and the new feature in this connection is the increase in the quantity of tea shipped from England to the Continent."—*Bristol Daily Press.*

Preserving Timber in the Ground.

In speaking of the well-known methods of preserving posts and wood which are partly embedded in the earth, by charring and coating with tar, it is said these methods are only effective when both are applied. Should the poles only be charred without the subsequent treatment with tar, the charcoal formation on the surface would only act as an absorber of the moisture, and, if anything, only hasten the decay. By applying a coating of tar without previously charring, the tar would only form a casing about the wood, nor would it penetrate to the depth which the absorbing properties of the charcoal surface would insure. Wood that is exposed to the action of water or let into the ground should first be charred, and then, before it has entirely cooled, be treated with tar till the wood is thoroughly impregnated. The acetic acid and oils contained in the tar are evaporated by the heat, and only the resin left behind, which penetrates the pores of the wood and forms an air-tight and waterproof envelope. It is important to impregnate the poles a little above the line of exposure, for here it is that the action of decay affects the wood first, and where the break always occurs when removed from the earth or strained in testing.—*Mechanic.*

"Tea Hair."

Mr. Thomas Greenish, F.C.S., in reading a paper on this subject at Plymouth, said it appeared that tea hair found its way into this country as an article of legitimate commerce at tolerably regular intervals. Its commercial name was "Pekoe Flower," and sometimes "Bloom of the Pekoe Flower." It was a product of Indian teas, not of those of China. It was purchased somewhat as a curiosity, but some bought it regularly. It was never sold as tea simple, or for mixing with tea for sale: it was almost a necessity that it should be sold alone, for if it were mixed with ordinary tea it had such a tendency to separate and agglomerate into lumps, that any attempt of this kind would most probably result in the whole being returned as an adulterated tea. Mr. Wigner, in his analysis of the tea hair, gave theine 1·5 per cent., as compared with 3·5 per cent. for Pekoe tea, and Mr. Groves remarked in reference to this that "it was interesting to find theine present in the tea hair." The author doubted the correctness of this conclusion; and by several qualitative experiments satisfied himself that the theine found by Wigner was derived, not from the tea hairs, but from the extractive adhering to them.—*Grocer.*

Effects of Tar on Insects.

The action of tar oil upon insects and small animals injurious to agriculture appears to be rapidly fatal. Professor Sell, who was despatched to Mullheim by Prince Bismarck on the occasion of the recent appearance of the Colorado Beetle at that place, reports that experiments made with the boiling oil show that the very smallest proportion of it is fatal to insects of all varieties, and that if all other means should fail, we have here an infallible exterminator, though its application to the soil in any considerable quantities would probably be followed for a time by a marked decrease in productive power. Another writer on the same subject states that he effectually exterminated a plague of mice from his field by introducing a spoonful of the oil into the most recent holes, and stopping up the rest. On following up the borrows with the spade it was found that all the mice had perished in their holes.

New Scheme for removing Stumps of Trees.

The following idea may be of use to many of our readers. It has been very successful in the backwoods of America. In the autumn bore a hole of one or two inches diameter, and about 18 inches deep. Put in 1½ oz. of saltpetre, fill with water and plug up close. In the following spring put in the same hole half a gill of kerosine oil and then light it. The stump will smoulder away without blazing, and will go to every part of the roots, leaving nothing but ashes.

RULES for the felling of Tax-paying Timber in Assam Proper.

1. The following rules apply to all forest lands in the districts to which they may be extended, with the exception of forests gazetted as reserved or open under Act VII. of 1865, and of forests on lands, the proprietary right in which Government has alienated fully or partially, whether temporarily or permanently.

2. The descriptions of timber coming at present under the denomination "tax-paying timber," and the rate at which each description is taxed, are given in the following schedule :—

No.	Native Names.	Botanical Names.	Royalty.
		First Class.	
1	Sâl	Shorea robusta	Rs 8 per tree.
2	Siru	Dalbalgia Sissoo	Rs 6 per tree.
3	Nahor	Mesua ferrea	
4	Ajhar	Lagerstræmia Reginæ	
5	Sam	Artocarpus Chaplacha	
6	Poma	Cedrela Toona	
7	Tita Sapa	Michelia Champaca	
8	Gunserai	Cinnamomum glanduliferum	
9	Uriam	Bischoffia Javanica	
10	Makai	Dipterocarpus sp.	
11	Koroi	Albizzia odoratissima	
12	Boga Poma	Chikrassia tabularis	
13	Halluch	Terminalia paniculata	
		Second Class.	
14	Barjamu	Eugenia magnifolia	Rs 3 per tree.
15	Banjamu	„ Jambolana	
16	Gomari	Gmelina arborea	
17	Bhe	Salix tetrasperma	
18	Bola	Morus lævigata	
19	Makria or Nagabhe	Schima mollis	
20	Khair	Accacia catechu	
21	Phul Sapa	Michelia oblonga	
22	„ Hingori	Echinocarpus teliaceus	
23	Bar „	Castanopsis tribuloides	
24	Hilikha	Terminalia citrina	
25	Amari	„ tomentosa	
26	Sonalu	Cassia Fistula	
27	Jutuli	Altingia excelsa	
28	Maj	Pithecolobium bigeminum	
29	Paroli	Stereospermum chelonoides	

3. The felling of tax-paying timber, otherwise than under these rules, is forbidden.

4. Any person desirous of felling any tax-paying timber shall apply to the Deputy Commissioner, or the officer in charge of the Sub-division, on unstamped paper in the Form A. given in the Appendix, and shall, at the same time, tender the tax on the timber at the prescribed rate.

5. If there is no objection to the felling of the timber applied for, the Deputy-

Commissioner or Sub-divisional Officer shall receive the tax and enter the particulars of the application on a register which he shall keep in the said Form A. Having entered his initials on the application, he shall return it to the applicant, who shall take it to the forest ranger, or, when the forest ranger is not available, to such other officer as the Deputy Commissioner or Sub-divisional Officer shall direct.

6. The forest ranger or other officer shall mark the trees to be felled, and shall note having done so in the application.

7. When the trees are felled, the feller shall apply to the mouzahdar of the mouzah in which they have been felled, to whom he should show his application form, and the mouzahdar shall mark the logs with the number they bear in a register which he shall keep in Form D. The mouzahdar shall then give the feller a certificate in Form B., and shall permit the logs to be removed.

8. If any person wishes to bring timber of any of the tax-paying descriptions felled in any locality to which these rules are not extended within the boundaries of any district to which these rules are extended, he shall make application verbally or in writing to the mouzahdar of the first mouzah of any such district into which he may import the timber. The mouzahdar shall mark the logs with the numbers they bear in his register D., and give the importer a certificate in Form C.

9. Any tax-paying timber found in the possession of any person without mark, or in excess of the number entered in his certificate, will be attached and sold, and the proceeds credited to Government.

10. Any person who has lawfully felled tax-paying timber within lakhiraj or waste land grants, for the purpose of exporting it beyond the boundaries of such grants, should apply to the mouzahdar of the mouzah within which such grants are situated, and on receipt of such application the mouzahdar shall proceed as directed in Rule 7.

THE REPORT OF THE COMMISSION ON THE LABOUR DISTRICTS EMIGRATION ACT.

We the Commissioners appointed by the Bengal Government Resolution of the 13th December 1880, to consider and amend the Labour Districts Emigration Act, VII. (B.C.) of 1873, have the honor to make the following report.

2. We submit a copy of the proceedings at our meetings, and the draft of a Bill embodying the amendments which we consider desirable in the system of inland labour transport. Owing to the illness of Mr. Forsyth, Assistant Secretary to the Bengal Government in the Legislative Department, we have had no professional assistance in drawing up the Bill. This fact may perhaps serve to explain or extenuate any defects that may be found in its form and phraseology.

3. From the official and other papers laid before us, and from our own personal knowledge of the subject, we find that the present "Labour Districts Emigration Act" is defective in respect chiefly of the points numbered I to IV below:—

I.—In that it does not afford sufficient encouragement to free emigration.

II.—In that it imposes unnecessary restrictions upon sirdari recruiting.

III.—In that it fails to provide for the enforcement of contracts made otherwise than under the provisions of the Act itself, even in the case of imported labourers.

IV.—In respect of the remedies provided for employers in the event of the unlawful absence, idleness, or desertion of their contract labourers.

4. The proceedings of the Bengal Legislative Council show that in 1873 the local Government recognized, in some degree, the propriety of encouraging "free emigration" and "free recruiting;" by the former of which terms was apparently meant the spontaneous and unsolicited emigration of natives of other parts of India to the labour districts, while the latter term was intended to apply to a system of inducing such natives to emigrate, and furnishing them with the means of doing so, carried on by, or on behalf of employers, without any supervision or control on the part of Government officers. The Lieutenant-Governor (Sir G. Campbell) seems indeed to have held that it was only the difficulty and expense than attending the conveyance of labourers to Assam which rendered it expedient to give to both employer and labourer the protection of special law. Had communication been easy and emigration for the purpose of finding employment common, no case would, in his view, have existed for applying any other than the ordinary law of master and servant. Sir G. Campbell does not, however, appear to have fully noticed the difficulties attendant upon the control of native imported labour in a country like Assam, and the impossibility of working it successfully without some more stringent sanctions than are afforded by the ordinary contract law. He did not specially consider whether the ordinary law of master and servant was in itself sufficient to meet the exigencies of the case. His first idea, therefore, when amending Act II. (B.C.) of

1870, was to allow any native of India to go as a free emigrant to the labour districts, but not to recognize any contract made by him before his arrival there, unless it were made under the provisions of the Labour Act. After arrival, this free immigrant might enter into any contract he pleased, but only under the ordinary law. He would be liable merely in damages if he broke it; and it was, owing to the competition for labour in the districts, generally to his interest to break it as soon and as often as he could. It was moreover at that time practically impossible for a native of the districts of Western Bengal and Behar to transfer himself and his family to the labour districts without substantial assistance in money from some source or other. But the scheme proposed by Sir G. Campbell held out absolutely no inducements to an employer to incur the risk of making advances to defray the expenses of such emigration. While the labour law and this suggestion of the Lieutenant-Governor were under the consideration of the Bengal Council, the anticipations of scarcity in Behar gave the subject of emigration increased importance. It was contemplated that Government and private employers desiring labour should assist emigrants to reach the labour districts, and in order to draw forth such assistance from the tea planters the Lieutenant-Governor modified his first suggestion so far as to propose that the law should recognize contracts made by emigrants at any place, and for any time, up to the limit of one year from the date of their arrival in the labour districts. But this contract was still only to be an agreement enforcible by suit under the ordinary civil law of contract, and the provisions of section 7 of Act VII (B.C.) of 1873 in which the suggestion was ultimately embodied, have so far as the free recruiting of emigrants and placing them upon contracts in their own districts is concerned, remained practically a dead letter.

5. No employer at present enters into a contract with an intending emigrant in the district of the emigrant's home, otherwise than under the provisions of the Act, and the impression has been general, among both employers and the officers of Government, that to recruit labour in Bengal or Behar, otherwise than in accordance with these provisions, was altogether illegal. This misconception of the law was exposed in a circular to district officers issued the year before last by the Government of Bengal on the representation of the Chief Commissioner of Assam; but it is certain that, so far as the districts of the Assam Valley are concerned, very little advantage has been taken hitherto of the concession embodied in section 7 of the Act. It is still not fully understood that a free emigrant may be put upon civil contract for a year in the district of his recruitment, and an Assam planter, especially in the remoter districts, does not care to run the risk of taking such an emigrant up to the garden at considerable expense, only to have him, in the absence of all legal engagement, enticed away by the liberal offers of some other employer, or to be met by a refusal to contract except upon the further payment of a substantial bonus.

6. In the case of Cachar and Sylhet there has been the same indifference to the permission given by the law to put an intending emigrant on contract for a year before he leaves his own district; but owing probably to the fact that transport to the Surma Valley has usually been by country boat, and subject therefore to but little interference and supervision, a practice has grown up of extensive free recruiting to supply the wants of those districts, the labourers being put upon contract for a year on their arrival there. (In some instances indeed the law has been directly evaded, and three-year contracts taken from such immigrants, on the theory that after arrival they became local labourers. But, of course, no contract which is not made under the Act can be enforced otherwise than under the ordinary law, and though Act XIII of 1859 has been doubtfully applied to such local contracts in some districts its provisions were obviously never intended to meet such cases. There is, therefore, a universal complaint that the employer is, in the absence of a penal law, insufficiently protected in respect of local contracts, and recourse is only had to the system of free recruiting in places where it has been tried because the alternatives of contractors' recruiting and sirdari recruiting are under present restrictions unduly expensive.

7. The general conclusion arrived at, not only by us but by all who have been consulted in the matter, is that, looking to the increased facilities of communication with the labour districts, to the fact that the conditions of labour there are now thoroughly understood by the class from which the labourers are drawn, to the greatly ameliorated condition of the labourers themselves in the tea districts, to the great importance of colonizing the eastern and relieving the pressure of population in the western districts of the Bengal Provinces, and to the urgent necessity at the present time of assisting the tea industry in which so much capital has been embarked, no unnecessary obstruction should now be thrown in the way of the emigration of natives of other parts of India to the labour districts under contracts made as in the Act provided; and that nothing should interfere with the making of such contracts by free emigrants and other local and time-expired labourers within the labour districts themselves.

8. Those employers who can draw a sufficient supply of labour to their tea gardens without incurring the expense of employing a regular agency to recruit and to execute

contracts in the recruiting districts, may be left to make their own arrangements. When free emigrants arrive ready to work for such employers, or where local labourers or others are willing to enter into contracts with them under the Act, they should be allowed to do so, it being provided that every labourer placing himself under the penal provisions of the Act shall be entitled also to benefit by its protective clauses. If any employer objects to this, he should be at full liberty to make with his labourers any contract which the ordinary law of the country will recognise and enforce.

9. On the other hand, there are districts more remote and employers so locally circumstanced, as to make it necessary in their case that the emigrants going to recruit their labour force should be actually put on contract before leaving the province on their engagement. We propose to meet their wants by relieving sirdari recruiting of many of the restrictions which now apply to it.

10. At present the garden sirdar is regarded with suspicion by the law, by the Magistrates of recruiting districts, and by his employer. The law compels him to present himself at the Magistrate's court of the district where he proposes to work that he may get his license countersigned—a requirement which at once brings him into dubious relations with the cutcherry amlah. His certificate is only allowed to run for six months. He is not permitted to travel in company with another sirdar if the total number of their united bands of emigrants exceeds twenty. If he recruits more than twenty emigrants himself, he must take them to a contractor's depôt, becoming, to all intents and purposes, a contractor's recruiter. The local Magistrates in the recruiting districts have done little to help, and in some instances much to hinder the work of even *bonâ fide* garden sirdars. The sirdars are kept hanging about the courts while enquiries are made by the police in regard to their recruits, or while the Magistrate is absent from the station or engaged on other work. They have to fee underlings to assist them in getting registration effected, and they find it often impossible, owing to the delays and 'hustling,' to keep together the emigrants they have with pains collected. At the same time the employer finds that he on his part has no control over the sirdar when once he has left the garden. His contract was to remain and labour on the garden, and when he arrives at his home, he not unfrequently ignores his employer entirely, and decides to remain where he is. He sometimes disappears altogether with the advances made to him, or fritters the money away, and then declares his inability to move until he gets further supplies. He is tempted by contractors' recruiters and crimps to make over to them, for a consideration, emigrants recruited at his employer's expence; either filling up their places with worthless substitutes, or declaring that the labourers deserted after taking the advances he had been instructed to offer them. When he is placed under the control of a contractor or his local representative, as is sometimes done, he generally becomes merely a recruiter with a free license, who collects emigrants for the contractor rather than for his employer, receiving a commission on every man he brings in.

It must be remembered also that the whole of the local influence of the contractors and their professional recruiters is thrown into the scale against the *bonâ fide* garden sirdar, who works only by himself and for his employer.

11. We have no doubt whatever that most of the abuses attendant upon the engagement of natives of India for emigration purposes have been attributable to the operations of professional contractors and recruiters; and we believe that the only way to put inter-provincial emigration on a sound and natural basis, and at the same time to diminish the cost of procuring labour, is to sever all connection between garden sirdars and contractors' depôts, and to give the widest scope to the working of the sirdari system; providing at the same time, in the employers' interests, for the effective control of the sirdars when engaged on recruiting duty. The fiction that the garden sirdar is sent back to induce only his own immediate relatives to return to the garden where he has prospered must be given up. He must be recognized as a recruiter, but as a recruiter directly commissioned by the employer himself, with personal knowledge of a labourer's life, and of whom his employer has personal knowledge. He should not be allowed to degenerate into a professional crimp, and his certificate should, therefore, run only for a limited period, and be renewable only with the consent of the Magistrate of the Labour District.

12. We should have been glad to see the contractor and his recruiter abolished altogether. But apart from the injury to individuals which the summary closing of an industry would certainly inflict, it is probable that there are some gardens which are not yet in a position to employ sirdari recruiters, and must, for the present, depend upon professional assistance in procuring labour. Provision has, however, been made in the Bill drawn up by us for supplying by means of specially Licensed Local Agents the wants of new gardens when (as may be hoped will soon be the case) contractors and their depôts shall no longer exist.

13. On the subject of the defective provision in the present Act for the enforcement of locally-made contracts, and the treatment of unlawful absence and desertion of labourers in the labour districts, we can add nothing to the facts and arguments set forth

in the letter to the Government of India from the Secretary to the Chief Commissioner of Assam, No. 2065 of the 28th October last and its enclosures. It is only necessary emphatically to endorse all that is there said as to the absolute necessity of providing a penal contract law to secure employers in the tea districts against the serious losses to which they would be liable under a system of purely civil contract. But we hold equally strongly the view that if a labourer consents to subject himself to a penal labour law, he is entitled to demand also the protection of law in respect of his general relations with his employer. If he surrenders to some extent his freedom, the law must compel the employer to provide for his wants, must secure to him his wage, must protect him against overwork, and must shield him from ill-usage of all kinds. This being so, it seems by far the simplest plan that all penal contracts to labour should be made under the same Act. There is good reason to believe that local and time-expired labourers in the tea districts are fully alive to their own interests, and not likely to be coerced or deceived into making any contract of the terms of which they are in doubt, or which they disapprove. In deference to the almost unanimous wish of the tea planters, we propose to permit the extension of the maximum term of contract under the Act to five years: but we think it probable that in most cases local contracts will continue to be made for shorter terms, and the only effect of bringing such contracts under the Act will be that there will be no sudden disruption or change in the position of imported labourers when the term of their first engagement comes to an end. They will simply make a fresh bargain in full knowledge of all its conditions, and will continue to receive the same protection as during the first term of their residence in the labour districts.

14. With these preliminary observations, explanations, explanatory of the general policy we have adopted, we proceed to notice in detail the amendments and alterations proposed by us in the Labour Law.

Act VII (B.C.) of 1873—*Preamble—Draft Bill—Preamble.*—The last clauses of the preamble have been altered to indicate the extended purview of the proposed law. Instead of providing merely for the protection of persons proceeding under contract to the labour districts, and for the enforcement of contracts of service entered into by them, it is proposed to provide generally for the enforcement of contracts of service made under the Act, and for the protection of all persons entering into such contracts.

Act VII (B.C.) of 1873, *Sections* 1 *and* 2—*Draft Bill, Sections* 1 *and* 2.—The necessary verbal changes have been made in the 'Title' and 'Repealing Section.'

Act VII (B C.) of 1873, *Section* 3—*Draft Bill, Section* 3.—In the interpretation clause the following additions and alterations have been made:—

(1).—A definition of the term 'Local Government' has been given, by which the Lieutenant-Governor of Bengal and the Chief Commissioner of Assam respectively will exercise within the districts subject to their several jurisdictions the powers given by law to the 'Local Government.' There being two 'labour districts' under the Lieutenant-Governor, it is necessary to employ a phrase that will cover *both* the Lieutenant-Governor and the Chief Commissioner in respect of matters with which both must deal.

(2.)—To simplify the wording of many sections, the phrases 'Inspector' and 'Assistant Inspector' are defined to mean respectively 'Inspector of Labourers' and 'Assistant Inspector of Labourers' under the Act.

(3.)—To remove doubts, it is expressly stated that a 'garden sirdar' may be either 'male or female.' The employment of female sirdar recruiters, who are generally the wives of garden sirdars, is very desirable. The Magistrate can always refuse to countersign the certificate of any objectionable female.

(4.)—The 'Local Agent' is practically a new creation of this Bill, although in some districts, Calcutta Agency houses at present employ a class of local agents, taking out for them either contractors' or recruiters' licenses. His duties and responsibilities are defined in sections 21 to 23. The intention is, that he should control the operations of garden sirdars in the recruiting districts, provide them with the necessary funds, and act generally as the representative of his employer. He can never, under any circumstances, be a contractor, but with the special permission of his employers, and special license from Government, a local agent may be allowed to engage labourers for new gardens without the intervention of a garden sirdar.

(5.)—A provision is made in section 45 for licensing 'sub-contractors,' and a 'sub-contractor' is here defined to be a contractor's local representative. It is better to bring such men under control by recognizing them formally in the Act, than, as at present, either to ignore them, or compel them to take out recruiters' licenses.

(6.)—The Definitions of 'Emigrant' and 'Labourer' have been modified to suit the policy of the Bill. 'Emigrant' will now merely mean a native of India, of the age of 16 years or upwards, who proceeds to emigrate, while 'labourer' will mean any labourer who has made a contract under the Act. A definition of 'dependent' has been inserted to meet doubts which have arisen in practice, and save a separate section in the body of the Bill.

(7.)—'Estate' is defined to mean the lands upon which any labourers (as well labourers defined in this Act as others) have been engaged to labour. This, with the definition of 'Manager,' is necessary to meet the case of gardens employing imported free labour from which returns are necessary for statistical purposes.

(8.)—'Rule' is defined to mean a rule formally made and duly notified under sections 5 and 6 of the Bill.

Draft Bill, Section 4.—A power is given to the local Government to exempt any labour district from the provisions of the Bill. It is probable that Sylhet, and very possible that Cachar, may be able shortly to do without any special Labour Law.

Act VII (B.C.) of 1873, *Section* 4—*Draft Bill, Sections* 5 *and* 6.—A distinction has been drawn in section 5 between those rules which either of the two local Governments concerned may be called upon to make for its own province, and those of which the Lieutenant-Governor of Bengal alone or the Chief Commissioner of Assam alone will have to frame. The description of the subject-matter of the rules has been made in some instances more precise, and in some more general. Any changes made in substance will be more conveniently noticed in connection with the sections of the law to which the clauses severally refer.

We would, however, specially draw the attention of Government to the importance of having all rules carefully framed as far as possible in consultation with the leading representatives of the interests affected by them. So much important detail is left to be regulated by rules that full publicity and opportunity of discussing their bearing should be given to those concerned before they are finally passed by Government.

Draft Bill, Section 7.—This is a new section, and provides that any sums advanced by any Government officer under certain sections of the Bill on behalf of an employer, a garden sirdar, a contractor or the master of a vessel, shall be recoverable under the Public Demands Recovery Act, VII (B.C.) of 1880, which it is presumed will be extended to Assam. If it is not so extended, these advances should be made recoverable by civil suit.

Act VII (B.C.) of 1873, *Section* 5—*Draft Bill, Section* 8.—All contracts under the Act, and all arrears of wages due under such contracts, are made, as at present, a charge upon the estate, and will be transferred therewith. When the labourer contracts to labour upon any one of several estates belonging to the same employer, it is provided that the contract is to be a charge upon the estate on which the labourer may for the time being actually labour.

Act VII (B.C) of 1873, *Section* 9—*Draft Bill, Section* 9.—The present Act enables a native, when *above* the age of 16 years, to make a valid contract under the Act. It is proposed to say *of or above* that age, which is practically the way in which the law is interpreted and worked.

Act VII (B.C.) of 1873, *Section* 15—*Draft Bill, Section* 10.—The section regulating the terms of a contract under the Act is brought into the preliminary chapter as being now intended to be a section of general application, regulating the contract of local as well as of immigrant "labourers." We have raised the maximum limit of time to five years, and provided for payment in accordance with the system of task-work universal in the labour districts. It has been thought essential to provide for a minimum rate of wage for a fully completed task and for a higher minimum in the fourth and fifth years of service, to which it is proposed that the contract term may now be extended. These changes have been made in accordance with the almost unanimous demand of those interested in the tea industry, concurred in by both the Chief Commissioner of Assam and the Lieutenant-Governor of Bengal. The argument in favour of the extension of term is that it is only thus that the employer can be fairly recouped his preliminary outlay and risk in importing the labourer and maintaining him while he gets acclimatized and learns his work. Looking, however, to the fact that a time-expired labourer can now always command a bonus on re-engagements, we consider that he is entitled to higher wages for the same *amount* of work in the later years of his services. He will moreover ordinarily be able to get through his task more quickly, and thus earn by extra work a full remuneration for his own improved capacity. Provision is further made for the deputation of a garden sirdar on recruiting duty during the currency of his contract.

It is proposed that the contract should be either to work upon any specified estate, or upon any estate belonging to the employer in the same labour district, as the parties to the contract may desire. Labourers frequently wish to work on some particular and favourite garden. On the other hand they may be ready to work indifferently on any garden belonging to their employer in a certain neighbourhood. But where the engagement is thus general in terms, the labourer is protected against separation from his family.

Act VII (B.C.) of 1873, *Schedule A*—*Draft Bill, Schedule A*.—The form of contract has been simplified, so as to be suitable for execution either in the recruiting districts or in the labour districts. Specific reference is made in it to the supply of house accommodation, medical attendance, food grain and rations, because those are matters which ought to be brought under the notice of the intending labourer. It is presumed that the rules of the local Government on the supplying of food grains will be furnished to every

registering officer, so that he may be in a position to give the necessary information to emigrants brought before him for registration.

Act VII (B.C.) of 1873, *Section* 7—*Draft Bill, Section* 11.—Section 7 of the present Act prevents the execution of contracts to labour in the labour districts for more than one year, save under the provisions of the Act. In accordance with the policy already explained, section 11 of the Bill permits the free execution of contracts to be enforced only under the ordinary civil law. It also declares in unequivocal terms the legality of free emigration. But it maintains the protection now given to emigrants (*i e.* to persons not natives of the labour district) who may accept in ignorance an engagement to work on a garden declared unfit for the residence of such emigrants when on contract under the Act.

Act VII (B.C.) of 1873, *Section* 8—*Draft Bill, Section* 12.—No change has been made in the general section regarding penalties; but to remove doubts, it is provided that all fines under the Act are to be recoverable under the Criminal Procedure Code.

Act VII (B.C.) of 1873, *Section* 9—*Draft Bill, Section* 13.—The section relating to procedure on trial of offences remains unchanged.

Act VII (B.C.) of 1873, *Sections* 10 *and* 11—*Draft Bill, Sections* 14 *and* 15.—The section conferring on the local Government the power of forbidding emigration and immigration under the Act has been made more general, but the previous sanction of the Supreme Government ought, in our opinion, to be required to an order affecting the interests of more than one province.

Act VII (B.C.) of 1873, *Section* 12—*Draft Bill. Section* 16.—The section providing for the appointment of officers and their subordinate establishments is made more general in its wording. It will probably be found desirable to appoint more than one Superintendent of Emigration. The Government can, under the rules, define the duties of each; and it is provided elsewhere in the Bill that Government shall also determine which of the Superintendents under it shall license contractors, &c. The same remarks apply in respect of embarkation officers and their power to license vessels. We attach special importance to the appointment of as many registering officers as possible. At present the delay and expense caused by there being only one Magistrate at each station empowered to register are very serious. There seems to be no good reason why the Civil Surgeon, or any other officer of Government, or any Honorary Magistrate, should not act as a registering officer.

Act VII (B.C.) of 1873, *Sections* 13, 16 *to* 32—*Draft Bill, Sections* 17 *to* 44.—Sections 17 to 44 contain our scheme of sirdari recruiting. In the first place, the certificate granted to the sirdar must set forth the principal points in the instructions given him by his employer, and, as disobedience in respect of certain of these instructions will subject him to penalties, he is required to accept and sign the certificate in the presence of the Inspector or a Magistrate of the labour district. The certificate will be in force for 12 months; but if the employer finds that any sirdar is a good recruiter, he may, with the consent of the Inspector or Magistrate of the Labour District, renew his certificate from time to time. The certificate need not be countersigned by the Magistrate of the recruiting district; nor is the sirdar bound to take his recruits for registration to such Magistrate, he *may* do so if most convenient, or he may start on his journey with them, and put them on contract at any registering station to which he may come on his way to the labour districts, provided only that he puts them on contract before he leaves the province of Bengal This provision is intended to save delays, and to enable an employer to secure the registration of his labourers at the place where he may find it most convenient to keep a 'local agent.' The Government of Bengal will, it is hoped, multiply the facilities of registration by recognizing as many stations as possible. It is not proposed that special stations should be set apart for the registration of emigrants belonging to particular tracts of country. But no doubt in practice the tendency will be to put emigrants on contract at such places as Raneegunge and Hooghly where there would ordinarily be a break in the journey; Raneegunge being the station where Chota Nagpore emigrants would take advantage of the railway, and Hooghly being the place where emigrants booked through to the Northern Bengal State Railway might be required to cross the river so as to avoid Calcutta. The garden sirdar will take emigrants with him out of their own district at his proper risk. If they decline on reasonable grounds to contract when brought before a registering officer, they will be returned to their homes at the employer's expense. No medical examination as to an emigrant's fitness to labour will be made as a matter of course; but if the employer wishes to secure such an examination, he will only have to note this on his sirdar's certificate, and the registering officer will see that the instruction has been attended to. Any Government medical officer will be bound to make the examination on payment to him of a fee of eight annas per labourer; or the employer or his local agent may make their own arrangements with any qualified medical man. An emigrant who unreasonably refuses to contract after money has been spent in bringing him to a district other than his own, will be liable to penalty. Any registering officer may prevent the emigration of any native brought before him who seems unfit to travel, or

affected with disease dangerous to others, if on medical examination these facts are established. Garden sirdars are to be allowed to make their own arrangements for the accommodation of their emigrants; and any central depôts provided by them will be subject only to reasonable sanitary supervision. No restriction will be imposed on the number of labourers a sirdar may recruit; but every gang of 20 labourers going to the labour districts must be in charge of a responsible person, who will look after them and pay their way.

To further economy, it is provided that a garden sirdar may, with the consent of his employer's local agent, take charge of emigrants engaged for another employer so long as his gang does not exceed twenty. Garden sirdars failing to carry out their orders with reference to putting emigrants on contract, or deserting or embezzling moneys, or abandoning labourers *en route*, will be liable to prosecution wherever found, and the employer's local agent may prosecute in all such cases. The sirdar is made liable to minor penalties if he pay into hands of contractors, or have any working connection with contractors or contractors' subordinates. Every gang of labourers will be accompanied by a nominal way bill on which all casualties will be noted, and which will eventually be returned by the employer to the Superintendent of Emigration. There will thus be a complete record of the working of the system of sirdari recruiting in the Superintendent's office, obtained with the minimum amount of trouble to all concerned. Any Magistrate or Embarkation Agent or Inspecting Officer *en route* may detain any labourer or dependent found unfit to travel, or diseased in a manner so be dangerous to others. If any employer desires to have his labourers brought through Calcutta and inspected by his agents there, this can be done under section 43, even although the contract may have already been executed at another registering station.

Act VII (*B.C*) *of* 1873, *Sections* 33 *to* 51—*Draft Bill, Sections* 45-66.—But little substantial alteration has been made in the sections relating to contractors and the operations of contractors' recruiting. Provision has been made, as above noticed, for the licensing of sub-contractors. The power of the Superintendent to cancel licenses during their currency for misconduct has been made more clear. The forms of licenses have been left to be regulated by rule. Contractors are to be bound to establish depôts wherever the Lieutenant-Governor of Bengal considers these necessary. They have also been made civilly liable for the conduct of their subordinates. The medical examination of intending emigrants has been restricted to ascertaining whether they are fit to travel and free from contagious disease. It has been made clear here (as well as in the chapter on sirdari recruiting) that the registration fee is to be paid on every native produced for registration, whether eventually rejected or not. The work imposed on a registering officer is greater in the case of a rejected than in that of an accepted labourer.

Act VII (*B.C.*) *of* 1873, *Sections* 52 *to* 60—*Draft Bill, Sections* 67 *to* 76.—The sections for the regulation of contractor's depôts remain substantially unaltered. The functions of the Medical Inspector in connection with the depôt have been more clearly defined, and his examination of the labourers is confined to ascertaining their continued freedom from contagious disease, and their fitness to travel to the labour districts. In section 76 provision is made for the supply of way-bills to gangs of labourers sent from contractors' depôts in the same manner as in the case of sirdari gangs.

Act VII (B.C.) of 1873, *Sections* 61 *to* 94—*Draft Bill, Sections* 77 *to* 99.—An important change has been made in the provisions relating to transport. The present law deals only with the transport of 'emigrants' as there defined; that is to say, labourers under contract, and natives of India under actual engagement to contract with some particular person, special provision being made in certain matters for the protection of the former class. In view of the fact that, if free emigration develops, the number of native passengers by river steamer and country boat who are under no actual engagement may form the majority of those travelling by such means of conveyance, it seems necessary to give the Government a power of enforcing general sanitary regulations without reference to the classification of passengers. Accordingly provision is made for licensing all vessels carrying more than twenty native passengers, and a power is taken in section 5 to make rules for the ventilation, cleanliness, and water-supply of all such vessels, and for their inspection on the Assam rivers. But, lest any such system of licensing should interfere unduly with the ordinary river traffic in country boats, the local Government is authorized to relieve any vessels or class of vessels from the obligation of obtaining license. This being the general principle on which the Chapter on 'Transport' has been framed, we proceed to notice a few of the modifications in detail.

Draft Bill, Section 77.—The transport of native passengers and emigrants to Chittagong must apparently be regulated by the Native Passengers Act of 1876; accordingly we have declared that the provisions of the Bill will not apply to such transport.

Act VII (B.C.) of 1873, *Sections* 62 *&* 63—*Draft Bill, Sections* 78 *and* 79.—These sections are modified in accordance with the general principle above described, but the fee for license for a single voyage is reduced to

a maximum of Rs. 16, instead of four annas per labourer carried, and provision is made for the grant of periodical licenses to vessels running regularly. It is probable that very shortly there may be, if not a daily, at any rate a bi-weekly, accelerated steam service between Dhubri and Debrooghur. It would be intolerable to subject these vessels to measurement for license before every voyage, or to charge them a heavy license fee on each occasion. The provisions of the law to ensure punctual despatch, and prevent overcrowding, have been modified to suit the new system.

Act VII (*B.C.*) *of* 1873, *Sections* 61, 67 *and* 68—*Draft Bill, Section* 83.—It is believed that, with a proper system of way-bills, it is unnecessary to maintain any express provisions of law for embarkation passes and lists. The way bills of all gangs of labourers received on board should be kept by the master during the voyage, and the master (or medical officer) should enter on these all casualties occurring on board. He need then only submit such returns of "gangs" and casualties as the Government may by rule prescribe. The long nominal lists and multifarious passes may be entirely dispensed with.

Act VII (*B.C.*) *of* 1873, *Sections* 69 *and* 70—*Draft Bill, Sections* 84 *and* 85.—The arrangements for *labourers* on board must continue to be regulated by rule, but as under arrangements now coming into force the provisions and medical officer will be supplied by the steamer companies, these sections have been modified to meet the present requirements. All medical officers employed must hold a Government license, and be liable to removal for misconduct.

Act VII (*B.C.*) *of* 1873, *Section* 72—*Draft Bill, Section* 87.—It is unnecessary to provide in the law for detention of vessels at all Magistrates' stations. The local Government can most conveniently arrange by rule all such points of details, and the section has been modified accordingly.

Act VII (*B.C.*) *of* 1873, *Sections* 75 *to* 78—*Draft Bill, Section* 90.—The powers of an Inspecting Magistrate to detain vessels on account of disease among the passengers are restricted somewhat in order to meet the requirements of the present accelerated service.

Act VII (*B.C.*) *of* 1873, *Sections* 81 *to* 88—*Draft Bill, Section* 95.—It is proposed to leave all the procedure for disembarking labourers and despatching them to their destination, to be regulated by rules, which can be modified to suit local and varying circumstances.

Act VII (*B.C.*) *of* 1873, *Section* 89—*Draft Bill, Section* 96.—At present the Magistrate of the district or division can only depute a Subordinate Magistrate to do inspection duty. It is proposed to allow him also to depute any medical or gazetted police officer.

Act VII (*B.C.*) *of* 1873, *Sections* 93 *and* 94.—These sections are rendered unnecessary by the changes made in other parts of the Draft Bill

Act VII (*B.C.*) *of* 1873, *Sections* 95-99—*Draft Bill, Sections* 100-102.—We propose in sections 27 and 61 to reduce the registration fee to a maximum of the rupee per head. In section 105 a similar fee is proposed for the registration of local contracts under the Act. In section 1000 the same maximum is provided for the yearly rate. Looking to the large number of locally engaged labourers that are likely to come under the Act, it is probable that a very much smaller sum will bring in the income necessary to defray the cost of working the Act. We strongly recommend that the Government should adopt a sliding scale of registration fees with reference to the length of the contract term. It is not advisable to throw any obstacle in the way of the registration of local agreements under the Act, and if local contracts are generally made for one year only, it will be unfair to charge the full registration fee on every renewal. For the reasons set forth in the proceedings of our Fifth Meeting, to which we would specially invite a reference, we have decided to recommend that no more income should be raised by fee and rates than is actually sufficient to pay for the Government machinery required to work the Act. Any surplus accruing should, as in the case of the zemindari dâk-cess, be appropriated to reducing the fees and rates for the following year. These sections are modified to give effect to these views; but the rate is made recoverable under the Public Demands Recovery Act, 1880. If that Act is not extended to Assam, the provisions of the present law may be restored.

Draft Bill, Sections 103-106.—These sections provide for the execution of contracts under the Act by locally engaged labourers, whether immigrants or residents.

Act VII (*B.C.*) *of* 1873, *Sections* 98-105—*Draft Bill, Sections* 107-111.—The provisions of the law regarding returns and registers to be made and kept by employers have been modified in the manner recommended by us at our Fourth Meeting. It is necessary for statistical purposes to provide for the submission of returns of imported labour in certain cases even when not on contract under the Act, and for the inspection of such labourers, and this has been done. The duties of Inspectors are left to be more particularly defined by rules. But we would suggest that in any such rules it should be provided that the Inspector shall, if possible, give notice of his intention to visit a garden for the purpose of mustering the labourers.

It may often be very inconvenient to an

employer to have to call them off their work without notice or preparation.

Act VII (B.C.) of 1873, *Sections* 106 *to* 109—*Draft Bill, Sections* 112 *to* 116.—The procedure for regulating task-work, and the payment of the labourer, is made more precise; and, while the employer is relieved of the obligation of submitting the schedule to the Inspector in the first place, the Inspector is empowered to order the alteration of anything that seems unreasonable, subject only to an appeal by the employer to a Committee. As the employer will now, under section 131, have an easy remedy in all cases of unlawful absence from work, we have made it clear that every labourer is entitled to his weekly day of rest, and to wages on that day. If he absents himself from work on other days, the proper course for his employer to follow is to report him to the Inspector, not to compel him to work on the only day he can claim for marketing or going about his own affairs. A new provision is inserted to meet the case of labourers who, though not actually sick, are weak and unable to earn as much as half the minimum rate of wage.

Act VII (B.C.) of 1873, *Sections* 110 *to* 112—*Draft Bill, Sections* 117 *to* 120.—In the sections relating to "incapacity to labour," a new provision has been made for occasional absence of the labourer, caused by sickness, not being of such a permanent character as to warrant the interference of the Inspector and the suspension of the contract. It is proposed to allow 30 days' grace on this account in the year on half pay only, after which the days of absence will be added to the contract, unless the labourer shall refund the subsistence allowance drawn by him during absence. This section will only apply to absence from work caused by sickness; and seems, therefore, a concession which it is reasonable to make to the labourer, especially as we have below given the employer an easy remedy against unauthorised absence of other kinds.

Act VII (B.C.) of 1873, *Sections* 113 *to* 117—*Draft Bill, Sections* 121 *to* 127.—The most important change under the heading "Necessary provision for labourers" is the omission from the contract of all reference to the supply of rice. In the prospect of emigrants from Behar forming in future a large majority of the labour force of the province, it seemed unreasonable to stipulate for the supply of rice only. On careful consideration of the whole question, we have come to the conclusion that the best plan is to give power to the local Government to make rules for the supply to labourers of the staple food-grain suited to each class, when this is not procurable at reasonable rates in the local markets. The Government may, we think, be trusted to determine, on equitable principles, what are reasonable rates, and at what prices the employer should supply his labourers. Local circumstances vary so greatly that what may be reasonable in one district would be most unfair in another, but no doubt the matter would always have to be regulated by reference to the labourer's wage as the *ultimate* standard. We have also made provision for a modified system of rationing in exceptional cases. In the case of Behar labourers a reasonable system of rationing in the early months of service will, we believe, often prevent serious mortality. We recognise however all the difficulties attendant on the introduction of any such system; and our proposals are therefore of a moderate and tentative character. The wording of the section regarding hospital accommodation and medical attendance has been made more general, so as to enable the Government to sanction necessary arrangements in a manner as little burdensome as possible to individual employers.

Act VII (B.C.) of 1873, *Sections* 118 *to* 120—*Draft Bill, Sections* 128 *to* 130.—The only change in the chapter relating to localities unfit for the residence of labourers is that provision has been made for closing a garden against some particular *class* of labourers without barring the employment of all labourers.

Act VII (B.C.) of 1873, *Section* 121—*Draft Bill, Section* 131.—At present the penalty for unlawful absence of the labourer from his work can only be enforced by complaint before a Magistrate. An employer cannot, however, spare time to make the journeys to court every time one of his labourers plays truant. It is proposed, therefore, to allow him to submit to the Inspector a monthly list of defaulters, giving at the same time notice to each such defaulter that he has entered him in the list. The Inspector will, on his next visit, enquire into each case and endorse the days of absence on the contract unless the labourer agrees to forfeit four annas for each day of absence. Prolonged and repeated absence may still be punished by a Magistrate if the employer chooses to complain, and the penalties for this have been made more severe.

Act VII (B.C.) of 1873, *Section* 122—*Draft Bill, Sections* 132 *to* 134.—The sections regarding "desertion" have been modified in the manner recommended by the Chief Commissioner of Assam. The deserter may be arrested without warrant, but he must be taken to the nearest police station where, after his statement and that of the captor have been recorded, he may be taken back to the estate of his employer. The Magistrate will, on perusal of the statements, judge if further enquiry is necessary, and act accordingly.

Draft Bill, Section 135.—A new section has been inserted providing a punishment for habitual drunkenness and wilful disregard of sanitary regulations. In most Colonial Ordinances cognizance is taken of the former

offence: and as regards the latter it seems to us that, where the consequence of sanitary neglect may be so serious to the employer, he should have some means of punishing wilful offenders against duly promulgated orders.

Act VII (B.C.) of 1873, *Section* 128—*Draft Bill, Section* 141.—As recommended by the Chief Commissioner of Assam, rigorous imprisonment for one month has been provided as a possible punishment for enticing away or harbouring labourers.

Act VII (B.C.) of 1878, *Section* 129—*Draft Bill, Section* 142.—Under the heading of "Complaints by labourers," it is provided that a labourer desiring to complain must be sent by his employer to the Inspector or Magistrate. But to prevent stoppage of work by the labourers complaining *en masse*, it is proposed that if more than ten labourers come forward to complain, the employer shall send notice to the Inspector or Magistrate to come and enquire. The present Act only takes notice of complaints to an Inspector, but it seems desirable to extend the procedure under the chapter so as to allow complaints to any Magistrate. Such complaints would not always fall within the purview of the Indian Penal Code and Criminal Procedure Code, or even necessarily have reference to a distinct offence under the Labour Act and Rules. The labourer should be allowed to bring anything that he feels to be a grievance before the nearest protective officer. When a labourer is sent in to make his complaint, the employer would probably send a peon with him to prevent desertion. Provision is therefore made in section 142 for the award of compensation to the employer if the complaint is shown to be untrue or frivolous.

Act VII (B.C.) of 1873, *Section* 134—*Draft Bill, Section* 147.—Provision is made for the *immediate* recovery of wages due to a labourer whose contract has determined. The employer has no right to keep such a man on his garden by detaining his wages.

Act VII (B.C.) of 1873, *Sections* 136-138—*Draft Bill, Section* 149.—Instead of leaving the completion of the contract to be registered and endorsed by the Inspector, the obligation is thrown upon the employer of endorsing on the contract of each labourer the fact of its determination. The labourer will keep this as equivalent to a discharge certificate, and the other endorsements on the contract will show any new employer what the labourer's conduct has been during his former engagement.

Act VII (B.C.) of 1873, *Section* 137—*Draft Bill, Section* 150.—The labourer is given the right to redeem the contract of any member of his family as well as his own, and the value now fixed for the unexpired period of the third year of any contract has been declared to extend to unexpired period of the fourth and fifth years.

Act VII (B.C.) of 1873, *Section, Schedules B to F.*—It is much more convenient to leave all *forms* to be laid down by rules of the local Government.

15. In conclusion, we desire to urge upon Government not merely in the interests of the tea industry, but in those of the whole province, the importance of devoting continued attention to the improvement of communications with and throughout the Labour Districts of the Assam and Surmah Valleys. We believe that it is in this way, rather than by any scheme of Government emigration, that the waste lands of Assam will ultimately be colonised and reclaimed. Every year sees an increase in the numbers of the resident population brought there in the first instance to meet the requirements of tea cultivation. If communication is made easy, rapid, and cheap, we cannot doubt that in time there will set in a natural spontaneous emigration from the over-peopled districts of North Behar to the fertile rice tracts of Assam. Every Behari labourer who can be kept in health during his contract term, and returned to his home as a garden sirdar, serves as a living stimulus to bring about such a movement. It is to Behar and the North-West that the tea-planters must, in the future, mainly look for their supply of labour. It is to Behar and the North-West that the Government must look for the working population to reclaim the wastes of its North-Eastern Frontier. In this view we feel it right to place in the very foreground of all schemes of improvement (apart from the introduction of an accelerated river service, which the local administrations are already doing much to secure, and the making of good roads in the labour districts themselves) the completion of those links in the interprovincial railway system which will make it a simple and an easy matter for the Behari labourer to journey to Assam for work, and which will at the same time serve to stimulate his settling there, by removing those sentimental ideas of distance and separation that more than anything else at present act as a deterrant upon voluntary and permanent emigration. We have the less hesitation in urging this matter, because experience seems to prove that almost *any* railway in Bengal must be a profitable investment for capital. Already lines are under construction which will, when completed, link Bettiah, near the Eastern Frontier of the Ghazipore district in the North-Western Provinces with Peepra Ghat on the Eastern limit of Durbhanga. If that line were continued through Purneah and North Dinagepore to Parbuttipore on the Northern Bengal State Railway, the whole of North Behar and the trans-Gan-

getic portion of the North-West Provinces would, when the Kaunia-Dhubri tramway is finished, be in direct railway communication with Assam. A line from Caragola to Parbuttipore would place the districts to South Behar, Monghyr, and Bhagulpore in an equally favourable position. Each of these lines would pass through tracts of country rich and fertile in ordinary years, but still not altogether secure against famine. Apart, therefore, from their value as emigration routes, they would serve the double purpose of bringing the surplus produce of those tracts more readily to market, and of insuring the districts through which they run against the worst effects of scarcity. On the other side of Bengal we would point out that almost everything has yet to be done to develop the trade of the teeming districts of Dacca, Mymensingh, Sylhet, and Cachar. The Government of Bengal is, we have reason to know, fully alive to the great commercial and administrative value of the schemes to which we have referred; and we trust that it will lose no opportunity of pressing them upon the favourable consideration of the Government of India and of Her Majesty's Government.

A. Mackenzie, *President*.

W. Aitchison, H. F. Brown, J. G. G. Grant, L. Hare, A. B. Inglis, C. Macaulay, A. Wilson, *Members*.

The 20th January 1881.

MINUTE BY MR. H. F. BROWN.

PARAGRAPH 15 alludes to an accelerated river services which, the Committee has been informed, is being undertaken by Government. I am interested in river steamers. I agree that a daily and accelerated steam service to Assam would be an advantage to that district, and I am aware that European opinion is almost unanimous upon the point. That is natural. A similar, and probably equally unanimous, opinion prevails amongst passengers by other goods-carrying services, such as the P. & O. Company for example. I do not agree that the proposed acceleration is so urgent as to demand Government interference—certainly not in competition with the liberal offers of steamer companies.

The history of the river steamer companies is that, when plying on the Ganges, all but one were ruined by the competition of a State-guaranteed railway. The one survivor and another resuscitated company transferred their fleets to the Brahmaputra, where, after having, by much labour and expense, developed an important traffic, they are again threatened with State competition.

This tendency of the Government to engage in trade is alarmingly on the increase, and unless that policy be authoritatively reversed, no private enterprise can be regarded as secure. Thus, we should not be tempted, by the anticipation of special conveniences, to countenance a policy which must seriously interrupt the development of private enterprise in this country.—*Calcutta Gazette, January* 26.

HENRY F. BROWN.

PART VIII.—STATISTICAL.

Tea Reviews and Statistics for 1880.

It is with no feeling of satisfaction, when one reads over the weekly reports of the whole year, to write a summary of this important trade. The end of 1879 will be remembered on account of the speculation and high prices that ruled both in this and in almost all other branches of trade. It is needless to say that those high prices were unwarranted, and everybody, from the small grocer to the outside speculator, has had to suffer, and they are only just beginning to recover from their reverses. From the commencement of January until June it was simply a question of getting out of high priced stocks at the smallest loss possible, and the heavy imports which the high rates had encouraged the Chinamen to bring forward (notwithstanding the assertion that the season of 1879-80 was 20,000,000lbs. short, and that not another leaf was procurable), helped to make the fall greater than it otherwise would have been. Even with a short crop of 20,000,000lbs. there was no reason in a rise of 6*d.* per lb., as there is always a large enough stock in the country to meet such a deficiency for one season, at all events. The importers will not understand that, although the stock in bond may look small, yet the low rates that have ruled of late years had induced many wholesale and retail grocers to hold large stocks, and this one fact alone was proved by the persistent way in which buyers continued month after month to hold off operating. An immense amount of tea was held by outside speculators, and such was the excited feeling, that there was scarcely a clerk (many only in the receipt of 50*l.* per annum) who did not hold at least one hundred half-chests! All this had to come again on the market as the prompts became due, and if it had not been for the shippers, who bought most freely anything that was offered them, it is difficult to say what would have become of the stuff, as most of the dealers, being unable to sell in the country, were selling their heavy stocks at large discounts on the market.

The total shipments from China for the season up to date are above last year, while those from India are greatly in excess.

The total exports from China and Japan for the season 1879-80 was 160,000,000lbs., against 161,000,000lbs. in 1878-79; and we commenced the present season of 1880-81 with a stock of 58,700,000lbs., against 54,500,000lbs. in 1879; thus showing an increase in stock of 4,000,000lbs. The general figures are satisfactory as showing a total delivery of over 200,000,000lbs., against 198,500,000lbs. in 1879. The quantity for home consumption has been 156,000,000lbs., against 161,500,000lbs. in 1879; thus showing a decrease of over 5,500,000lbs; but on the other hand, the exports have been 44,500,000lbs., against 37,000,000lbs. in 1879, or an increase of 7,500,000lbs.; making a total increase in deliveries of about 2,000,000lbs. Our imports for the year will be about 198,000lbs., against 184,000,000lbs. in 1879; and 202,000,000lbs. in 1878. It is not satisfactory to think that the consumption in this country is going off tea, but although the figures show this falling off, yet we believe it is only on paper, and the real explanation is that, owing to the badness of the times, grocers hold smaller stocks. This argument is fully borne out by the heavy deliveries of the last two or three months, and is one of the many signs of returning prosperity and confidence after nine months of depression. The large export trade was not anticipated, and we have every reason to be thankful for the timely relief of the shippers.

* * * *

Indian Tea.—It will not be found satisfactory to those interested in the future of Indian tea growing to look back through the year, and to see at once the immense losses most of the gardens must have sustained, brought about partly by over-production and also by the poorness of the crop which over-production must induce. The cost of making is known mostly about 1*s.* 3*d.* per lb. all round, and yet the average price made by the bulk of the gardens has been 1*s.* per lb., we believe. It was pointed out last year that, however cheap Indian tea became, the consumption would not exceed about 40,000,000lbs. for some years to come; and that, on account of the bitterness and general uselessness of the lower-priced grades, Indian tea would not cut out the more useful and lower-priced China kinds. The latter can be, and are, drunk without mixing, whereas only a small proportion of Indian is required to add a point and pungency to the cheap and good China growths. Last season, from July 1879 to June 1880, the imports were about 39,000,000lbs., but the present season is expected to yield about 45,000,000lbs., a large proportion of this increase having already arrived, thus over-flooding the market to such an extent that prices have ruled ruinously low. These low prices have certainly created a large country demand, and deliveries for the last two or three months have been over 4,000,000lbs. per month. These increasing deliveries are no doubt very encouraging to those interested, but we would point out that one had better not reckon on such good deliveries continuing unless the general consumption also increases in proportion. In 1879 the deliveries were 35,250,000lbs., but this year they are about 42,000,000lbs. The total imports for 1880 are about 44,000,000lbs., or 6,000,000lbs. more than in 1879. The stock on January 1, 1881, will be about 2,000,000lbs. more than last year. The quality of the new season's has been generally poor, hence the over-supply and very low rates ruling, for common to

medium grades, while fine to finest being scarce, have met with eager competition, and extreme prices have been obtained. The year began with very heavy sales, and a general decline each month ensued for common to medium kinds, but finest were scarce and dear. In April the low rates stimulated the demand, and prices were firm In June some new season's came to hand, but they were poor and undesirable. In August, as the crop to hand improved, so did prices, and anything with quality and strength commanded extreme rates (or 1*s.* per lb. over their nominal value). The market kept firm with a good demand until October, when the very heavy supplies brought down all medium to fine grades 4*d.* to 6*d.* per lb., and also common kinds. This fall created an enormous demand, and for the rest of the year a large trade was done, with heavy deliveries. Supplies were equal to the occasion ; consequently prices only just kept firm at the low rates current in October.

* * * *

For months past doubts have been expressed as to the correctness of the figures relating to the receipts and deliveries of tea at this port, the returns furnished by the dock and wharf companies not agreeing with those issued by the Customs and Board of Trade authorities. The difference between one set of totals and another has not been a matter of a few hundreds or thousands, but has amounted to "millions" of pounds' weight, and has consequently occasioned some confusion in the minds of many with reference to what have been the quantities of tea actually landed and delivered in London during the past year. The only explanation that could be given was that the calculations from the dock returns were based on the old scale of average weights, whilst the estimates formed in official departments were founded on teas that had been specially weighed. As month after month showed the same inconsistencies between totals representing similar branches of trade, it at last became manifest that the aggregate weight of packages imported had to the unofficial compilers imperceptibly increased, leaving always a net overplus of tea which was never properly taken into account, and which was included only when the Custom House returns were periodically made up. If it had not been for the latter, wherein extra vigilance is shown for the sake of securing every six pence of revenue that can lawfully be obtained, it is likely that the deficient mode of reckoning might have gone on unnoticed for some time longer, and that the statistical movements of the article for 1880 would have been wrongly and imperfectly represented. A few words will explain how it is that so great a discrepancy has crept in almost unperceived. Half-chests of "Congou" and "Souchong," which were formerly calculated to weigh only 56lbs., or about half a cwt., are now estimated at 60lbs. net, and packages of Indian or Assam tea, usually reckoned at 90lbs., are now known to average 97lbs. each, so that as these are the very descriptions which figure most prominently in all statistics of tea, it is not surprising that the deficit existing between the private estimates and the official amounts, duly ascertained for the purpose of assessing the duty to be charged on the tea passing into consumption, should be so remarkable as we have endeavoured to show.

Fuller particulars, however, are needed to prove the extent to which recent miscalculations have deranged the comparative landings, clearances, and stocks of tea with those in 1879, and we select the totals published by Messrs. J. C. Sillar and Co. as the latest and most carefully revised that we have yet seen on the subject. According to their calculations, the total quantity *imported* into London last year was 206,564,000lbs., of which 137,763,000lbs. was "Congou," and 46,377,000 lbs. Assam or Indian, against 185,176,000 lbs. in 1879, which included 123,774,000 lbs. "Congou," and 37,518,000lbs. Assam. The total deliveries for all purposes were computed at 205,679,000lbs., against 196,490,000 lbs., the separate amounts of Congou and Indian being 137,079,000lbs. and 43,835,000lbs. in 1880, against 135,484,000lbs. and 34,097,000lbs. in the preceding year. Equally striking was the amount estimated as stock, *viz.*, 100,258,000lbs., as compared with 96,188,000lbs. at the end of 1879, the proportion of Congou on hand being 67,425,000 lbs, against 64,288,000lbs. in the previous year, and that of Assam figured as 21,225,000lbs., in contrast with 18,274,000 lbs. But it should be remembered that the excess in the landings, deliveries, and stocks, here given, and which in each instance is much larger than before known, would be smaller if the quantities pertaining to 1879 were adjusted by the present method of calculating the actual weights of the chief kinds of China and Indian tea warehoused and delivered.

It is also interesting to observe the great progress which the trade in tea has made within the past seven years. This is best shown by the enormous deliveries that have occurred in the United Kingdom under the three different heads of "Home consumption," "Exported," and "Transhipped," the subjoined statement enumerating these details being likewise taken from Messrs. Sillar's annual review of the London tea market, *viz* :—

	Home consumption.	Export.	Transhipped.	Total deliveries.
	lbs.	lbs.	lbs.	lbs.
1874 ...	137,500,000	31,000,000	8,800,000	177,300,000
1875 ...	145,500,000	31,700,000	11,342,000	188,542,000
1876 ...	149,182,000	27,835,000	6,238,000	183,255,000
1877 ...	151,275,000	35,000,000	13,000,000	199,275,000
1878 ...	157,692,000	39,551,000	8,299,000	205,542,000
1879 ...	160,652,000	36,170,000	8,406,000	205,228,000
1880 ...	158,570,000	42,499,000	11,544,000	212,613,000

—*The Grocer.*

INDIAN TEA MARKET REVIEWS FOR 1880-81.

BY THE LEADING LONDON BROKERS.

I.—*Dated Mincing Lane, 6th-7th January*, 1881.

THREE prominent features mark the record of the past year—increased supplies, depressed prices, and growth of consumption. The year opened unpropitiously, and the spring found dealers and speculators loaded with stocks showing heavy depreciation, while importers had to face a constantly declining market and a scale of prices disastrous to the producer. It was not until the autumn that any real improvement took place, and then heavy deliveries showed that the low price was telling in favour of consumption. This for a time imparted strength, and a permanent recovery would possibly have been established had it been practicable to regulate the supply. Arrivals, however, proved too much for the market, and prices again gave way, the lowest point being reached in October. Since then a partial reaction has set in, but it is mainly confined to fine grades, the bulk of the imports, consisting of ordinary to medium kinds, remaining almost at the lowest point. That there are grounds for expecting some recovery from the past depression the following considerations will show :—(1.) The average price has fallen, for a large portion of the crop, below cost of manufacture. (2.) Consumption—taking the last six months' deliveries as a test—has overtaken production for the current season, and perhaps for the next. (3.) A fresh market has been found for Indian tea in Australia, and there may be some prospect of success in America.

* * * *

The statistics made up to 31st December show how considerable has been the development in the Indian tea trade during the past twelve months, the imports being 6½ millions and the deliveries 8½ millions heavier than in 1879, the stock on 1st January being 20½ millions, compared with 17¾ millions last year. These totals are heavier than was expected, owing to the warehouses having returned the average nett weight of chests at 98lbs., whereas calculations have hitherto been reckoned on the basis of 92lbs. per chest. The increasing use of Indian has affected the Home Consumption of China, which has fallen off nearly 10 million lbs. during the year. These facts should have an important bearing upon the future of the industry.

WM. JAS. & HY. THOMPSON.

THE past year cannot fail to have greatly disappointed, not only the importers, but more especially the producers of Indian tea, inasmuch as the descriptions ranging from fair to good medium, which have constituted the bulk of the crop, have been realising a lower scale of prices than ever before noted. This must chiefly be ascribed to the over-production of all medium qualities, which compete so closely with the China growths, and of which we have received such large supplies; these are now selling at losses to importers, and far below the prices of any previous season. The total public sales in 1880 comprise some 510,000 packages, equal to 45 millions, against 470,000 or 42 millions in 1879; and in comparing prices we find all the finest lines quite up to previous year, while the other sorts show fully 2*d.* to 4*d.* decline, except commonest, which are much on a par. We are assured on all sides that at the present low average it will not pay to grow tea, yet there are several very encouraging features to be noticed: in the first place, the extreme rates paid all through a dull season for all the fine qualities, or anything showing strength and pungency, and also the increased consumption; this will prove that Indian teas are becoming more and more appreciated every year, and it will be found that the increase in the deliveries of 1880 is entirely due to Indian teas, the excess over last year's figures being 6,364,212lbs. Further, it is to be noted that Indian teas are finding other markets, especially in the colonies, and we hear from Australia that some 650,000lbs. weight have already been disposed of at satisfactory prices, and that further shipments are being made. For the future interest of all, we might venture to advise the proprietors of tea-growing gardens to endeavour year by year to make as high and uniform quality and as few sorts as possible, feeling sure that those gardens adopting this plan will find their teas commanding better competition than before. The imports of China tea fully keeping pace with the deliveries, no material change has taken place, but generally the market has shown a declining tendency, and good useful black teas are being disposed of at exceptionally low rates—from 9*d.* to 1*s.*, while common to good common we may quote at 7½*d.* to 8½*d.*

HULBERT & Co.

DURING this month 33,000 packages were offered at public auction. The steady all round demand existing throughout November continued through December up to the close of the market for the Christmas holidays. Ample supplies being again brought forward, no appreciable change has taken place in values, excepting for the better grades, for which there has again been a strong inquiry. As regards the quality of the teas offered, we note a decided improvement in the manufacture of many Cachar, Darjeeling, and Sylhet marks; and in consequence the teas from these districts have met with greater attention from the trade than Assam growths which, from their lack of quality, have been, com-

paratively speaking, neglected. Our statistics show that the deliveries continue to be satisfactory, being over a million pounds in excess of the corresponding month of 1879. The imports for the year were heavy, but we attribute this more to the increased facilities in the transit of teas from gardens and hence quicker despatch, than to any great increase in the actual crop. Quotations for the past month:—Broken teas: Dust 7½*d.* to 9*d.* per lb; red fannings, 7½*d.* to 8*d.* per lb; brown fannings 8*d.* to 9*d.* per lb; good liquoring and leafy sorts up to 10½*d.* per lb. Souchongs: Bold leaf, fair water, 9½*d.* to 10*d.* per lb; Pekoe Souchongs, fair to good, 10½*d.* to 1*s.* 1*d.* per lb; Pekoes and Broken Pekoes: Inferior, 11*d.* to 1*s.* 0½*d.* per lb; medium to fine, 1*s.* 2*d.* to 1*s.* 8*d.* per lb; finest, 2*s.* 4*d.* per lb up.

GOW & WILSON.

FROM the 17th to the 31st ultimo there were only two small sales, comprising 992 packages. This week, however, over 15,000 packages have been offered at public auction, which, considering the large quantity brought forward, have passed fairly well. The greater portion still consists of common and undesirable parcels, which have sold with difficulty, the rates ruling before the holidays being barely maintained. Common Pekoe and Broken Pekoe from 11*d* to 1*s.* 2*d.* show exceptionally good value. The better descriptions, on the other hand, especially if possessing quality in the cup, have met with good competition, and sold at firm prices. The figures just published are satisfactory, as, owing to the teas coming to hand sooner this season, the stocks are large; still, the deliveries have been correspondingly heavy, those for the month of December being more than a million pounds over those of 1879 for the same month. For the past six months the deliveries have been at the rate of 3,700,000lbs. a month, so that if this average is maintained until the end of June, and the total import for the season does not exceed 43 millions, the stock on the 18th of July should be about 13 millions, or rather over a million pounds less than at the same time last year. Advices from Calcutta by letter, dated 15th December, state that 5,500 packages had been sold there during that week. Prices for good to finest were firmer, but common descriptions, especially broken teas, were easier, as compared with the previous sale.

GEORGE WHITE & CO.

IN our review for 1879 we recorded that the lowest point Indian tea had hitherto touched had occurred in August and September of that year, but now we have to record that during the greater portion of 1880 an even lower scale has ruled for the bulk; this has had the natural effect in expanding the consumption of Indian tea at the expense of China growths, as will be seen from the following figures showing *a falling off* in home use of China during 1880 to the extent of 11,657,000lbs. and *an increase in Indian* of 6,364,000lbs.

The low range of price, although disastrous to producers in many instances, cannot be regarded but as highly beneficial to the future development of the trade, for nothing but a low scale of cost could have the effect of so quickly extending the use of Indian tea. That this increasing use is likely to be maintained we have no doubt whatever, provided that no material rise on present average values occurs, and should growers be enabled to meet the demand for fair qualities at moderate prices, there seems no reason why India should not furnish the larger proportion of tea in the future. In the meantime the use of Indian tea is becoming more general both unmixed, and mixed with China tea; in the latter case a much larger proportion is now used than formerly. We believe we are quite correct in stating that, where Indian growth has been used by retailers, it would be difficult, perhaps impossible, for them to do without it entirely.

The course of prices during the year has been a declining one for common and medium kinds, and a rising one for fine and finest.

The year commenced with a high range, due to the speculation for broken teas and Souchong sorts, and a moderate level for the finer qualities; but as supplies increased, values of the common kinds rapidly declined, as also did medium teas, whilst the position of fine, owing to scarcity, hardened until August, when a good demand set in and very inflated prices for any teas with real quality were obtained. As supplies increased, this animation rather subsided, but towards the close of the year, when it became apparent that fine teas would be very short, a better feeling set in and prices ruled higher. Medium teas also showed more firmness, but as the supplies of common were abundant, prices went rather easier, and there was not much disposition to buy freely except Fannings and Broken teas up to 8½*d.* and Souchong sorts up to 10½*d.*

Throughout the year the proportion of Broken teas, especially Broken Souchong and Pekoe Fannings, has been very large, these latter have been difficult to quit. Pekoes have also come forward in exceedingly large selection, and have met with a dragging sale at 11*d.* to 1*s.* 4*d.* although always offering good value. Broken Pekoes of medium to fine grades have been scarcer than usual this year. Finest kinds, as before noted, remained scarce.

Assam growths, with the exception of a few early in the season, have shown great falling off in quality, and are decidedly below the average.

Cachar and Sylhet growths have proved of quality rather above the average, and are now attracting more competition, as much attention has been shown in manufacture, especially in the former district.

Darjeeling teas have throughout the year

sold with good spirit, and prices have ruled rather higher in proportion to values obtainable in similar grades of other districts, whilst for finer makes the disproportion is even greater; the cause of this favour is the scarcity of flavoury China Kaisows, and perhaps also the more extended use of Indian teas without any mixture, for which purpose Darjeeling growths are very suitable.

Chittagong teas have been rather poor; Kangra Valley kinds scarce, with few of any good quality. Chota Nagpore teas have been indifferent. The Dooars district has sent some fair specimens of manufacture, and we look for good styles from this quarter.

Dehra Doon teas have hardly been seen here during the year.

Neilgherry teas have shewn fair style, and have sold with good competition.

Ceylon teas have again proved deficient in quality, and low prices only have been obtained.

Java kinds, since the spring, have suffered in consequence of the cheapness of Indian, and deliveries of late have considerably decreased.

It is worthy of note that sour, burnt, and thin burnt liquors have been very rare for a long time past—a proof of the greater care in manufacture now shown than in former years, when such undesirable makes formed no small portion of the supplies. The size of breaks has been larger notwithstanding that the splitting up system still prevails in Calcutta; the number of the lots at each day's auction here is very large, and as imports increase it will be necessary to endeavour to still further enlarge the size of the breaks, as buyers in some instances do not see parcels of less than about 15 chests, and with larger imports this limit may be still further increased.

Bulking in India seems to be extending, and as no objection is raised by buyers here, so long as the process is thoroughly carried out, much time, as well as expense, will be saved where bulking can be done properly in India without running risk of injury by climate.

Prospects of the market for the New Year should not be unfavourable, as the baneful results of the speculative mania have passed away, and trade generally throughout the country shows some improvement; moreover the basis of value with which this year commences is low, whilst the well maintained increase in the consumption should impart more confidence on all sides, even if the original estimate of the import for the present season prove nearly correct.

LLOYD & CHESHIRE.

THE inevitable reaction from a wild spirit of speculation and inflation of prices, such as occurred in the autumn of 1879, operated through the first half of the past year, inducing distrust of the market, and so reducing business to the bare necessities of the Trade,—as proved by a falling off in deliveries for Home use, and an almost uninterrupted decline in prices during this period. Such a state of affairs might naturally have been expected to ensure very moderate views for season 1880-81; but owing to competition among buyers for the Russian market, high opening rates were paid, and a considerable weight of tea sent forward at too high a cost; and later on, when prices had given way to some extent for black leaf teas, our market had become so depressed, through hard times, and overwhelming supplies of Indian leaf—prices for which, despite a previous low range, gave way 10 to 20 per cent. during September and October—that the business of the year must, we fear, prove disappointing to merchants; and it would have been very much more so but for the great increase in exports; shippers relieving the market of teas for which there was least Home trade inquiry, and so affording most opportune relief, and which was doubly fortunate,—the business proving profitable to shippers. Red leaf Congous are said to show worse results than black leafs, quality being generally inferior. We do not remember to have seen so low prices, quality considered, as have been current the last two months, for fair to medium Congous, say 9*d.* to 11*d.* per lb.; nevertheless there has been no sign of speculation, or even a desire to hold fair stocks until the past fortnight, when dealers evinced more disposition to do business. During the last month or two merchants have supported the market, being warranted in this course by a very easy range of prices for current qualities, and increased deliveries, which prove that the Trade throughout the country had been working on low stocks; we do not think Home Consumption has fallen off or even remained stationary, but that the seeming decline was due to distrust of the market. We are pleased to notice a lessened demand for low common tea, though this may be due in some measure to the depressed currencies for better qualities.

A special feature in the year's business is the large increase in Imports and Deliveries of Indian leaf; the former showing 17 and the latter 21 per cent. increase over those for 1879, while the stock on 31st December was only 15 per cent. in excess. Deducting Indian teas, and exports, from gross deliveries for 1880, it gives 115,620,000,lbs. as the quantity of China tea taken for Home use in the United Kingdom, as against 126,570,000lbs. consumed in 1879. These figures show a startling, though *continued*, displacement of China by Indian leaf. It is quite evident the production of tea is outstripping consumption, and all the more so if quality is not a necessity; it therefore seems as though one or other industry must give place; as if imports continue in excess of requirements, merchants are bound to lose money. The struggle between the produce of both countries is likely to be obstinate and protracted; we think China can

produce cheaper, but the taste for Indian tea is gaining ground in this country, and by the use of machinery and other economical appliances, planters expect to better their position, which has been a very trying one the last two or three seasons.

Indian Teas.—Offerings in January were heavy, but demand being principally confined to teas under 1*s.* 4*d.* per lb. and fine Darjeelings, a large percentage of medium and fine were withdrawn from sales. Business the succeeding two months was even more unsatisfactory, with a general decline of 1*d.* to 2*d.* per lb. in teas under 1*s.* 9*d.* per lb., the only grades showing steadiness being fine and finest at and over 2*s.* per lb. As an indication of the market, we may mention unreserved sales of 1,600 packages second hand teas in March at 2*d.* to 9*d.* per lb. under cost prices, though the original prompt on many of the teas had not expired. Continued heavy offerings in April and May, and a dull Country Trade, specially in Ireland, caused prices to droop a further 1*d.* to 2*d.* for teas to 1*s.* 2*d.* and 2*d.* to 3*d.* on better grades to 1*s.* 6*d.* per lb., though at the same time the market was hardening for really fine. Early in June a favourable change occurred, the offerings at auction being much reduced. Common Fannings advanced ½*d.*, and better teas to 1*s.* 2*d.* both whole and broken, ½*d.* to 1*d.* parcels with point and character over 1*s.* 4*d.* showing even a larger advance. The first new teas were sold early in June, 50 chests Darjeeling Co. averaging only 1*s.* 3¼*d.* per lb. During July and August, with a very inferior quality of imports and a continued dull Country Trade, undesirable teas to 1*s.* 2*d.* gave way ½*d.* to 1*d.* per lb. Heavy offerings in September caused a weaker market, specially for teas from 1*s.* 4*d.* to 1*s.* 10*d.*, but a regular break-down occurred early in October, when an average fall of 10 to 15 per cent. took place, grades under 1*s.* showing ½*d.* teas from 1*s.* to 1*s.* 6*d.*, 1*d.* to 2*d.*; 1*s.* 6*d.* to 2*s.* 3*d.* to 4*d*, and from 2*s.* to 2*s.* 6*d.* to 4*d.* to 6*d.* per lb. decline; though at the same time there was keen competition for teas with exceptional quality. The above-noted drop brought in buyers, and so a steadier market the latter half of October; strong liquoring broken Pekoes, at and over 1*s.* 4*d.*, fetching some advance. During November there was renewed weakness, teas to 1*s.* 4*d.* per lb. selling irregularly at an average decline, but which was recovered in December, the market closing more steadily. Assam teas are of inferior quality this season, and so the preference for Darjeeling growth has become more pronounced and general. Cachar teas seem also to be preferred, being of an intermediate quality and flavour, and this fact would seem to indicate a change in public taste. It is possible too free plucking, or some climatic influence, or a change in manner of preparation, may have operated against Assam produce; we have no doubt good strong, old-fashioned Assam teas will always command a ready sale, and favourable reception in this market. The science of blending is better understood now-a-days than in former years; and so we are told Darjeeling leaf is specially suited for mixing with Foochow Congous, as Assam growth is with black leaf. It is satisfactory to note the success which has attended the introduction of Indian tea into the Australian markets, which may prove a vent for a tithe of the production, as even this first year of trial the supply promises to exceed 1,000,000lbs.

SHEPARD & Co.

II.—Dated Mincing Lane, 13th-14th January, 1881.

There has been better tone in the market this week, and the sales have passed with more spirit. Prices for Pekoes from 1*s.* 4*d.* to 2*s.* may be quoted about 1*d.* to 2*d.* and Broken Pekoes fully 2*d.* dearer; whilst over 2*s.* both Pekoes and Broken Pekoes are fully 2*d.* to 3*d.* above the rates ruling in December. Under 1*s.* 4*d.*, Broken Pekoes possessing strength are firmer to the extent of 1*d.* to 2*d.*, whilst leafy kinds with point also show an advance. Broken teas and Souchongs are steady at previous rates. Darjeeling teas with quality are still in favour, as also some of the Cachar growth, whilst several Chittagong invoices have shown a marked improvement in quality. Kangra Valley teas are scarce, and the few offering are wanting in point and flavour. From Assam there are still very few good invoices, and although some tippy parcels have realised full prices, the quality, as a whole, from this district continue to be poor. The figures for the past twelve months have been re-issued, having been re-adjusted so as to make them correspond with the Board of Trade Returns. The total imports of Indian tea for 1880 are altered from 44,011,000lbs. to 45,010,000lbs., and the deliveries for the same period from 41,607,000lbs. to 43,807,000lbs., whilst the stock is changed from 20,223,000lbs. to 20,473,000lbs. Advices from Calcutta by letter, dated 22nd December, state that 6,000 packages were sold there on the 16th of that month. Common kinds were firm, but fine and finest were again dearer to the extent of 1*d.* to 2*d.* per lb. Darjeelings being in great request, realised extreme rates. During the week 12,877 packages have been offered at public auction.

GEO. WHITE & Co.

THE new year has commenced with rather less supplies at auction than had been anticipated, considering the large arrivals that took place during the holidays. Large quantities of fannings, broken teas, and Souchong sorts were offered on the first resumption of business; a decline of about ½*d.* per lb. took place; since then the proportion of these grades has been less, and whilst broken kinds are steadier, leafy makes up to 10½*d.* do not show signs of improvement. Pekoes are rather more saleable at 11*d.* to 1*s.* 1*d.*; over this range prices

show more firmness, and noticeable parcels at about 1*s*. 6*d*. to 1*s*. 10*d*. sell readily at a slight advance, whilst fine and finest command a rise of about 1*d*. to 2*d*. per lb. Broken Pekoes with strength are attracting more attention, and full rates are making from 1*s*. 2*d*. to 1*s*. 6*d*.; over this price about 1*d*. per lb more is obtainable, whilst fine and finest are extremely scarce and command rather inflated values.

LLOYD & CHESHIRE.

III.—Dated Mincing Lane, 21st January 1881.

A decided improvement in the tone of the market has taken place since the issue of our last report, and an extensive business has been transacted. The auctions have been heavy, comprising a total of 26,000 packages, nearly all of which have found buyers. As before, demand has chiefly run upon the higher classes, and competition has put up the price of the finer grades of broken Pekoes 2*d*. to 4*d*. per lb., and of Pekoe 1*d*. to 2*d*. per lb., while fair to medium grades of broken Pekoe from 1*s*. to 1*s*. 4*d*. have recovered 1*d*. to 2*d*., and similar kinds of Pekoe ½*d*. to 1*d*. per lb.; the lower classes, however, have not improved in value, Souchongs and Pekoe Souchongs from 9½*d*. to 11*d*. remaining at the previous level, while fannings and broken teas from 8*d*. to 9½*d*. being neglected, show even better value to the buyer than hitherto. The course of the market has been materially shaped by the small proportion of high class tea imported in recent cargoes, the absence of fine Pekoes being very noticeable, and this has stimulated the demand for fine broken Pekoes. The large proportion of broken and low leafy kinds, on the other hand, has depressed the value of these grades, so that in this respect the position is just the reverse of what it was about a year ago, when common grades were above, and the finer kinds below, the average price, upon which we remarked in our special circular issued at that time. That buyers more than ever appreciate fine tea has been demonstrated by the latest prices paid for the Dooteriah and Kalaj Valley marks, of which 226 chests were sold on the 13th at an average of 3*s*. 1*d*. per lb., the highest quotation being 3*s*. 8½*d*. for 50 chests of Pekoe. In September the average obtained was 2*s*. 5½*d*., the Pekoe realising 2*s*. 8½*d*.; meanwhile the prices have been steadily advancing, until competition among buyers of fine tea has raised the value of this mark nearly 8*d*. per lb. The peculiar and special merit of these teas consists in their possessing great strength and richness together with the highest flavour, a combination which hitherto it has been assumed that it is scarcely possible to attain.

WM. JAS. & HY. THOMPSON.

THE PAST AND FUTURE OF INDIAN TEA.

Table showing the Amount, Value, and Average Price per lb. of Exports of Indian Tea during the fifteen years, 1861 *to* 1876.

	AMOUNT. lbs.	VALUE. £.	Average price per lb.	REMARKS.
			s. d.	
1861-62	1,473,270	130,283	1-9·03	
1862-63	2,253,773	178,128	1-6·95	
1863-64	2,970,232	220,282	1-6·10	
1864-65	3,457,430	280,284	1-7·43	
1865-66	2,758,187	275,055	1-11·05	Highest price.
1866-67	6,387,088	340,785	1-0·80	Lowest price.
11 mths* 1867-68	7,811,429	686,928	1-9·23	*Commencement of official year changed from 1st May to 1st April.
1868-69	11,480,218	951,376	1-7·91	
1869-70	12,754,022	1,037,883	1-7·52	
1870-71	13,232,232	1,120,517	1-8·03	
1871-72	17,187,328	1,454,984	1-8·10	
1872-73	17,789,911	1,577,691	1-7·50	
1873-74	19,234,235	1,742,925	1-9·64	
1874-75	21,137,087	1,937,429	1-9·62	
1875-76	24,361,599	2,166,4[illegible]8	1-9·25	
Results of fifteen years.	164,238,036	14,100,966	1-8·59	Average for fifteen years.

A glance at the table, compiled from Government of India Returns, will teach many important lessons, and be of great use in showing those engaged in the production of tea how far they can safely go, as far as the Home Market is concerned. An element has entered into the calculation within the last five years, the effect of which we cannot fairly judge, without knowing more than we do at present as to the available area for tea and the probable increase of tea in future years in Japan; but, on the other hand, the population of the world and consequent consumption of tea is steadily on the increase; and besides, the consumption of tea per head in Britain and elsewhere has also greatly improved, and will doubtless continue to do so, more and more,

the better the quality of the bulk of the tea that goes into the market.

The Government of India calculates that there are more than half a million acres under tea throughout the Indian Empire.

Even making allowance for plant in utterly unsuitable areas, for young cultivation, and for land under native management, &c., we can hardly believe that the outturn per acre throughout India is likely only to be seventy pounds of tea during 1877; indeed we should feel disposed to place it at nearly double this amount, and we would place the average outturn per acre, when the whole area comes into full bearing, say five years hence, at certainly not less than two hundred pounds.

Assuming the above estimate of the amount of land under plant to be correct, the outturn ought to be not less than one hundred million pounds; but we feel sure that there must be some very grave error, and Government may possibly include what they call "land taken up for tea, but not yet planted," which in some cases is ten times the area actually under plant; and Colonel Money lays down that a man ought never to plant more than one-fourth of an area of 400 acres.

However, what we have at present more particularly to deal with is, the vast increase in the import of Indian tea into Britain, and the manner in which it has been received. The average price obtained during the last three years under review is nearly one penny per pound above the average for the fifteen years; and considering that the amount for the last of these years shows an increase of fifty per cent. on the year immediately preceding this triennial period, and that the increase in price is nearly two pence per pound, a thoroughly healthy state is surely indicated, and we see no reason to doubt, if due attention is paid to quality, that the average of the next triennial period will show equally favourable signs, though political considerations and the state of the Home Money Market will, perhaps, have even more to do with it than the quality of the tea. We believe that the present body of planters is fully convinced that quantity without quality would only cause tea to become a drug on the market.

A very common assertion is, that the bad quality of the tea manufactured in the earlier years under review had greatly to do with the crash in 1866. We consider that the above figures will show this not to have been the case, and no other year gives an average within a penny per pound of that of 1865-1866. The wretched price obtained for the teas of 1866-67 was the consequence, and not the cause, of the wide-spread ruin of that period. Indeed, it was a year of financial panic throughout the world. If the teas of this year were inferior to those of former years, it must have mainly arisen from the utter inability of tea-proprietors to advance the requisite funds for working expenses, and not from any fault of, or incompetence in, the local management. Further, the increase of tea over the previous year was something enormous, and this on a panic-stricken market was quite sufficient, of itself, to render the finest teas almost unsaleable. We are further driven to this opinion by the fact that, in the year immediately succeeding, Indian tea fully regained its natural position even with an increase (allowing for the month of April) of twenty-five per cent.*

In every case of abnormal increase of quantity over the previous year, the price has fallen; and in 1871-72, when it was very great, it barely

* The duty was reduced in 1864 from 1*s*. 6*d*. to 1*s*. per lb., and in 1867 to 6*d*. per lb.—the present duty.

maintained its position. These facts ought to teach us to imitate the tortoise rather than the hare.

We have a giant to contend with in China, and while we do not believe that India will ever become a "Jack the Giant Killer," she may grow into a giant of equal proportion, if she is only wise in time, and is content with real, if slow, progress. We have purposely excluded the results of 1876-77 from our calculations. We believe that the approximate amount was twenty-seven million pounds, and the value something like two and a half million sterling, which would bring the price nearer to that of 1865-66 than that of any other year, and would be about two-pence per pound above the general average,—an additional sign of its increasing favour.

We believe that the present low prices arise from temporary, rather than from permanent, causes, and that while present transactions are against planters, Indian tea has still a bright future.

During 1876 the exchange had a great deal to do with keeping up the price of tea, as many invested in it for home remittances ; but as most people who did so lost more by it than they would have done by adopting the ordinary course, this form of remittance is not likely to be again extensively adopted, except by merchants who thoroughly understand their chances, and the most suitable market for their teas. Further, only large breaks are looked upon with favour by the London tea brokers, who, we believe, unless the break reaches a certain number of chests, do not even take the trouble of sampling it.

POSITION AND PROSPECTS OF INDIAN TEA COMPANIES.

Although the crisis in which the Tea Industry now finds itself, equally affects the pockets of public companies and private owners, there is a difference in the recuperative powers, and therefore the future prospects, of large companies and of comparatively small private estates. In the former case the one started with a tangible capital, and any present indebtedness is probably out of proportion to the value of property concerned. Still, of course, this indebtedness prevents the declaration of dividends, and shareholders now find themselves reduced to very bad case. In fact a glance at the Share List reveals a truly appalling state of things. Out of some 90 Tea Companies, 48 last year paid little or no dividend, while the price quoted per share is almost nominal, and sales can only really be effected at a ruinous sacrifice.

In those cases where loss has continued for years, of course the case is even worse, but this burden is distributed over the many, and amongst men to whom the loss is less acutely disastrous, probably, by reason of the fact that it is surplus money over and above their current expenses of livelihood which they have invested. Granted that it is none the less disappointing to such shareholders to find their capital yielding no return, still, in judging of the probable effects of the present crisis, we must not run away with the idea that because a Company has been paying no dividends for several years, even, and is in debt to its agents, it must of necessity close. If some Agents or Banks are found unwilling to continue advances, others will, in very many cases, be found willing to take their place, by reason of the substantial security which lies behind. We would go further, and say, that in many cases it would be good policy for shareholders to raise, by de-

bentures, strictly among themselves, money to redeem fully all present indebtedness, and to provide, also, a working capital,—thus saving themselves the crushing charges they now have to pay. If they did not make money out of their ordinary shares, they certainly should, as things go, out of their preference shares. They would also have more real power of control over the operations of their Company, and the result could not but tend to the general advantage of shareholders. If a new *regime* of strict economy and more careful management be enforced, there is no reason why those Companies, whose property has not gone utterly to the bad, should not, in a few years, pull round. That the losses of the past will ever be made good in the future, is doubtful, for tea will not again give the financial return it once did. Production is bound to increase, and competition is becoming stronger in other parts of the world, while cultivation bids fair to be attempted in places where hitherto it has not been thought of. Still, with that greater attention to detail which we have referred to, and with the improvement to the highest point of cultivation and manufacture which, in all well-regulated Companies, is now likely to take place, the future outlook seems less gloomy than despondent shareholders seem to think; and we would therefore give a word of advice to those interested in public Tea Companies in India, not to allow themselves to become panic-stricken, and to recklessly sacrifice their property. If shareholders can in any way hold on to their shares, we would say, do so, and become your own money-lenders. We believe things have come to the worst, and that they will gradually mend. It must not be forgotten that one marked effect of the low prices lately prevailing has been to induce the trade at home to purchase much more largely of Indian teas than heretofore, and thus the percentage of mixture of India with China has greatly increased; while, also, the sale of our teas, pure, by reason of their present cheapness, has already begun. The taste for pure teas, which must thus be created, can only have one effect —that of a future considerably increased demand for our product; and if the deliveries for this year should increase in the same ratio that they did last year, and the forwardals do not exceed those of the last season, it is estimated that about July next there will be little or no stocks. The result of greatly diminished stocks would necessarily cause a marked and probably permanent increase in price for Indian teas; and, although the good which may thus accrue may be almost, at any time, partly undone (at any rate for the next few years) by a subsequent too liberal supply from this country, it is to be fairly assumed that people looking beyond the immediate present would not be so foolish as to abandon other markets they had already succeeded in opening up, simply for a possible gain by a re-diversion to the original market. We have heard the fear expressed that this *may* happen even now, in consequence of the sudden improvement in home prices; and that the efforts, hardly yet complete, for drawing Australia into our net, may receive a check on this side. We cannot believe this; nor that the Syndicate will take its hand from the plough, and leave untilled the rich harvests which undoubtedly await them, in time, in America and Canada,—not to speak of other markets which might and ought to be essayed.

Although the home market has hardened, too much dependence must must not be placed on a continuance

There are many circumstances which have led up to present improved prices. That prices *will* improve we have little doubt, but the change will be slow, and those will do well who receive the late increase of price with a due amount of caution. Too sudden a rise or fall is often caused by "speculation," or "necessity,"—not based on the real state of the market: although of course it is to a certain extent a straw which shows the way the wind blows. Public Companies must not be too hastily led away by present improved prices, and they must not relax their efforts to support the Syndicate in the attempt which has been begun to find new markets. As a matter of fact we have little doubt that people at home have magnified the possible effect of the Syndicate's operations, and that this may have had something to do with a better tone for Indian tea; but whether so or not, money spent in "prospecting" will be well spent, for that a return will in due course follow, few doubt. It only requires necessary funds, and perseverance for a sufficiently long time, and we do not think that time need be very long. It is not at all likely that China will ever send her best class teas to compete, on their individual merits, with ours; and if she does not, even our common growths will, as peoples' tastes become educated, supplant the ordinary Chinas, and dealers will not be found to indulge so much in "mixing" when they find they can get a pure tea at almost a like price as the "blended" article. Doubtless at first we must be content with a small profit, or even with no profit at all; but that is better than incurring, as we have latterly been doing, heavy positive loss. It is necessary, to prevent disappointment, to bear this in mind. If shippers to new markets run away with the idea that they are at once going to make their fortunes, they will find themselves mistaken. They must bring themselves to look upon the venture, *at first*, as one which may only *reduce* the loss they have been incurring but also, hopefully, as a venture which will ensure them *future* profit; and they must also take into consideration this fact—that for every million pounds of Indian tea withdrawn from the London market, a fairly perceptible increase of price for that which remains is likely to follow,—till, when the withdrawals reach a telling amount, profitable home prices may become the rule, and not, as now, the exception.

Our argument then, is that should the present improved prices continue and even increase, we should on no account slacken the efforts we have begun to make abroad, or limit the sphere and activity of our intended future outside operations.

Again we say to shareholders—take heart. You have everything to lose by abandoning your interest in tea now; but, most probably, something to gain by holding on. It is justly believed that the amendment of Act VII., which is about to take place, and which is quite in the direction sought for, cannot but exercise a considerable influence for good upon the tea industry; the opening of new markets is another step towards improvement; the increased and increasing appreciation of Indian tea at home is another; the abandonment of extensions is another; the necessity for higher cultivation and more careful manufacture is another; and last, though not least, the more economical conduct of public companies,—which may now be looked upon as of acknowledged admission and capability—will be found a furthur factor in the problem of how to save our great Industry from the ruin which has so nigh engulfed it.

IMPORTS AND DELIVERIES FORM 1870 TO 1880.

Shown under each classification of Tea.

	Import 1874	Delivery 1874	Import 1873	Delivery 1873	Import 1872	Delivery 1872	Import 1871	Delivery 1871	Import 1870	Delivery 1870
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Bohea ...	110,867,000	121,242,000	114,130,000	116,774,000	8,000	7,000	18,000	14,000	11,000	10,000
Congou ...					129,240,000	119,259,000	122.067,000	119.684,000	99,378,000	106,586,000
Caper	7,437,000	7,247,000	6,450,000	6,832,000	7,986,000	6,621,000	6,325,000	5,896,000	4,265,000	5,063,000
Oolong	2,014,000	2,075,000	2,297,000	2,126,000	7,602,000	5,803,000	6,270,000	6,482,000	5,214,000	5,679,000
Souchong	4,652,000	4,484,000	4,046,000	4,214,000						
Flow. and Bl. Lf. Pekoe and Hung Muey ...	361,000	400,000	408,000	274,000	512,000	402,000	539,000	505,000	479,000	467,000
Orange Pekoe ...	5,037,000	[illegible]	5,487,000	5,412,000	6,569,000	5,216,000	4,592,000	5,254,000	4,513,000	5,469,000
Twankay ...	139,000	198,000	168,000	162,000	145,000	259,000	221,000	206,000	290,000	234,000
Hyson Skin ...					27,000	26,000	40,000	42,000	20,000	12,000
Hyson	1,237,000	1,022,000	1,304,000	1,030,000	1,068,000	1,247,000	996,000	1,326,000	1,409,000	1,116,000
Young Hyson ...	3,088,000	3,096,000	4,110,000	3,555,000	4,294,000	3,943,000	3,715,000	4,240,000	4,168,000	3,862,000
Imperial and Gunpowder	4,510,000	5,239,000	5,848,000	5,404,000	6,470.000	6,046,000	5,249,000	5,599,000	6,255,000	5,495,000
Sorts and Indian Tea ...	18,374,000	18,618,000	19,390,000	19 304,000	17,748,000	16,986,000	16,101,000	14,179,000	14,101,000	13,973,000
Japan	534,000	422,000	342,000	413,000	581,000	1,185,000	1,117,000	323,000	397,000	539,000
Java	......	......	......	......	......	......	......	......	......	......
Total lbs.	158,250,000	169,500,000	164,000,000	165,500,000	182,250,000	167,000,000	167,250,000	163,750,000	140,500,000	148,500,000
Black ... lbs.	149,276,000	159,945,000	152.550,000	155,349,000	170,246,000	155.479,000	157,029,000	152,337,000	128,358,000	137.781,000
Green ... lbs.	8974,000	9,555,000	11,450,000	10,151,000	12,004,000	11,521,000	10,221,000	11,413,000	12,142,000	10,719,000
Of which Exported lbs.	......	32,000,000	......	34,000,000	......	39,500,000	......	40,750,000	......	30,750,000

[Continued on next page.

IMPORTS AND DELIVERIES FROM 1870 TO 1880.—(*Continued.*)

	Import 1880	Delivery 1880	Import 1879	Delivery 1879	Import 1878	Delivery 1878	Import 1877	Delivery 1877	Import 1876	Delivery 1876	Import 1875	Delivery 1875
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Bohea ... } Congou ...	132,338,000	132,621,000	117,697,000	129,515,000	132,264,000	129,845,000	123,812,000	130,124,000	131,205,000	125,000,000	139,446,000	123,399,000
Caper ...	7,386,000	9,507,000	9,512,000	9,390,000	10,016,000	8,698,000	9,100,000	8,033,000	6,881,000	7,593,000	7,395,000	8,618,000
Oolong	1,673,000	1,595,000	1,993,000	2,258,000	1,855,000	2,222,000	2,528,000	2,254,000	1,817,000	2,060,000	2,432,000	2,432,000
Souchong	3,198,000	2,965,000	2,735,000	4,344,000	4,298,000	3,754,000	3,992,000	3,744,000	4,183,000	3,564,000	3,552,000	3,756,000
Flow. and Bl. Lf. Pekoe and Hung Muey ...	160,000	223,000	158,000	460,000	535,000	248,000	301,000	184,000	163,000	240,000	272,000	390,000
Orange Pekoe ...	3,883,000	4,177,000	3,442,000	4,751,000	4 872,000	4,634,000	5,393,000	4,213,000	4,036,000	4,723,000	5,385,000	5,309,000
Twankay ... } Hyson Skin	40,000	30,000	29,000	94,000	37,000	54,000	49,000	72,000	62,000	82,000	123,000	130,000
Hyson	676,000	865,000	1,066,000	1,092,000	1,053,000	1,129,000	910,000	1,230,000	1,075,000	1,241,000	1,259,000	1,120,000
Young Hyson ...	2,423,000	2,188,000	2,387,000	3,003,000	3,172,000	2,949,000	2,105,000	3,026,000	2,448,000	2,909,000	3,673,000	3,595,000
Imperial and Gunpowder	3,383,000	3,082,000	3,155.000	3,881,000	3,854,000	3,810,000	3,751,000	4,130,000	3,504,000	4,404,000	4,897,000	4,769,000
Sorts and Indian Tea ...	45,729,000	44,161,000	38,865,000	36,478,000	36,852,000	37,558,000	33,753,000	28,780,000	30,253,000	27,257,000	26,114,000	23,851,000
Japan	201,000	172,000	150,000	392,000	288,000	408,000	806,000	710,000	623,000	427,000	112,000	131,000
Java	2,019,000	2,612,000	2,898,000	2,883,000	2,654,000	2,441,000	......	......	......	......	......	......
Total lbs.	203,109,000	204,198,000	184,077,000	198,441,000	201,750,000	197,750,000	186,500,000	186,500,000	186,250,000	179,500,000	195,000,000	177,500,000
Black ... lbs.	196,587,000	198,038,000	177,440,000	190,471,000	193,634,000	180,808,000	179,685,000	178,042,000	179,161,000	170,864,000	185,048,000	167,886,000
Green ... lbs.	6,522,000	6,165,000	6,637,000	7,970,000	8,116,000	7,942,000	6,815,000	8,458,000	7,089,000	8,636,000	9,952,000	9,614,000
Of which Exported lbs.	......	44,771,000	......	36,627,000	......	40,500,000	......	35,500,000	......	29,250,000	......	32,500,000

IMPORTS, DELIVERIES, AND STOCKS, FOR THE YEARS 1872 TO 1880 INCLUSIVE,

As they stood in each Month of each Year,—all classes of Tea inclusive.

	1880.			1879.			1878.		
Month.	Import.	Delivery.	Stock.	Import.	Delivery.	Stock.	Import.	Delivery.	Stock.
January ...	5,470,000	3,260,000	20,029,000	4,182,000	3,230,000	15,508,000	5,579,000	3,208,500	17,808,000
February ...	3,899,000	3,069,000	20,859,000	3,242,000	2,871,000	15,881,000	2,827,000	30,695,000	17,560,000
March ...	3,969,000	4,444,000	21,382,000	3,677,000	4,232,000	15,328,00	3,127,000	3,374,000	17,319,000
April ...	2,553,000	4,040,000	19,895,000	2,540,000	3,803,000	14,066,000	1,899,000	4,210,000	15,010,000
May ...	723,000	3,183,000	17,434,000	708,000	2,203,000	12,573,000	894,000	2,582,000	13,325,000
June ...	254,000	3,461,000	14,226,000	597,000	2,057,000	11,160,000	978,000	2,596,000	11,384,000
July ...	1,396,000	3,247,000	12,573,000	885,000	2,327,000	9,721,000	1,838,000	2,550,000	10,622,000
August ...	2,966,000	3,171,000	12,363,000	2,067,000	2,365,000	9,379,000	2,409,000	2,935,000	10,097,000
September ...	6,502,000	3,797,000	15,076,000	5,025,000	2,691,000	11,715,000	2,876,000	3,123,000	9,850,000
October ...	6,096,000	4,155,000	17,011,000	5,258,000	3,684,000	13,287,000	3,941,000	3,331,000	10,461,000
November ...	5,252,000	4,408,000	17,863,000	5,048,000	3,340,000	14,998,000	3,871,000	3,207,000	11,142,000
December ...	5,936,000	3,557,000	20,473,000	5,259,000	2,440,000	17,818,000	5,768,000	2,585,000	14,324,000
From 1st Jan. to 31st Dec.	45,010,000	43,807,000	20,473,000*	38,484,000	35,243,000	17,818,000*	36,007,000	36,766,000	14,324,000*

* These figures represent stock on 31st December.

	1877.			1876.			1875.		
Month.	Import.	Delivery.	Stock.	Import.	Delivery.	Stock.	Import.	Delivery.	Stock.
January ...	2,155,500	2,378,000	11,340,500	3,445,000	2,403,000	10,426,000	2,198,000	1,899,000	8,134,000
February ...	2,150,500	2,019,000	11,474,000	1,919,000	2,409,000	9,937,000	1,578,500	1,673,000	8,039,500
March ...	2,800,500	2,170,000	12,105,000	2,549,000	2,336,000	10,153,000	2,339,000	1,601,000	8,777,500
April ...	1,757,000	2,122,000	11,743,000	1,739,000	2,130,000	9,762,000	2,350,500	2,127,000	9,003,000
May ...	812,000	2,337,000	10,216,000	744,000	2,385,500	8,121,500	837,000	1,938,000	7,910,000
June ...	817,000	2,027,000	9,005,000	461,000	2,134,000	6,223,500	589,000	1,956,000	6,551,500
July ...	1,617,000	1,897,000	8,726,000	1,673,000	1,795,000	6,102,000	913,000	1,675,000	5,791,000
August ...	2,571,000	2,207,000	9,089,500	2,428,000	1,897,000	6,633,000	2,582,000	1,593,000	6,781,000
September...	3,285,000	2,549,000	9,829,000	3,227,000	2,272,000	7,587,000	3,001,000	2,123,500	7,688,500
October ...	6,581,500	2,922,000	13,488,000	3,595,000	2,414,500	8,769,000	2,344,000	2,347,500	7,673,000
November ...	3,913,000	2,905,000	14,496,000	4,064,000	2,556,000	10,280,000	2,842,000	2,328,500	8,188,000
December ...	3,424,000	2,480,000	15,424,000	3,540,000	2,003,000	11,818,000	3,309,000	2,014,000	9,485,000
From 1st Jan. to 3st Dec.	31,784,000	28,013,000		29,384,000	26,735,000		24,883,000	23,278,500	

	1874.			1873.			1872.		
Month.	Import.	Delivery.	Stock.	Import.	Delivery.	Stock.	Import.	Delivery.	Stock.
January ...	1,465,000	1,758,000	6,656,000	2,590,000	1,552,000	7,578,000	2,175,000	1,350,000	6,854,000
February ...	876,000	1,257,000	6,277,000	1,602,000	1,462,000	7,706,000	1,940,000	1,308,000	7,486,000
March ...	1,109,000	1,353,000	6,036,000	1,428,000	1,463,000	7,854,000	1,376,000	1,112,000	7,750,000
April ...	1,932,000	1,620,000	6,349,000	1,233,000	1,806,000	7,110,000	2,038,000	1,787,000	8,001,000
May ...	935,000	1,553,000	5,735,000	1,026,000	1,526,000	6,610,000	859,000	1,522,000	7,338,000
June ...	332,000	1,436,000	4,775,000	167,000	1,582,000	5,195,000	272,000	1,395,000	6,215,000
July ...	227,000	1,286,000	3,716,000	312,000	1,486,000	4,158,000	920,000	1,270,000	5,865,000
August ...	2,097,000	1,248,000	4,568,000	1,277,000	1,323,000	4,109,000	655,000	1,232,000	5,288,000
September ...	2,383,000	1,498,000	5,454,000	1,279,000	1,322,000	4,009,000	1,385,000	1,333,000	5,340,000
October ...	1,494,500	1,679,500	5,270,000	2,630,000	1,631,000	5,071,000	1,798,000	1,598,000	5,540,000
November ...	1,844,000	1,639,500	5,476,000	2,446,000	1,578,000	5,939,000	1,816,000	1,510,000	5,846,000
December ...	2,683,500	1,428,000	6,732,000	2,377,000	1,456,000	6,681,000	1,708,000	859,000	6,652,000
From 1st Jan. to 31st Dec.	17,378,000	17,756,000		18,367,000	18,187,000		16,942,000	16,276,000	

IMPORTS, DELIVERIES AND STOCKS.

PARTICULARISING EACH VARIETY FOR 1879-1880.

Imports and Deliveries of London and the United Kingdom, during the years 1880 and 1879, with the Stocks on the 31st December in each Year.

	LONDON.						UNITED KINGDOM.					
	IMPORTS.		DELIVERIES.		STOCKS, 31st December.		IMPORTS.		DELIVERIES.		STOCKS, 31st December.	
	1880	1879	1880	1879.	1880.	1879.	1880.	1879.	1880.	1879.	1880.	1879.
Congou	132,338,000	117.697,000	132,621,000	129,515.000	63,181,000	61,454,000	132,338,000	117,620,000	132,650,000	129,515,000	66,790,000	65,102,000
Souchong	3,198,000	2,735,000	2,965,000	4,344,000	2,723,000	2,507,000	3,158,000	2,735,000	2,965,000	4,344.000	3,037,000	2,844,000
Oolong	1,673,000	1,993,000	1,595,000	2,258,000	1,002,000	922,000	1,673,000	1,993,000	1,595,000	2,258 000	1,065,000	987,000
Flowery Pekoe ...	160,000	158,000	223,000	460,000	151,000	219,000	160,000	158,000	223,000	460,000	155,000	219,000
Scented Orange Pekoe...	3,883,000	3,442,000	4,177,000	4,751.000	2,151,000	2,446,000	3,843,000	3,442,000	4,177,000	4,751,000	2,148,000	2,482,000
Scented Caper ...	7,396,000	9,512,000	9,507,000	9,390,000	3,213,000	5,334,000	7,360,000	9,512,000	9.507,000	9,390,000	3,342,000	5,372,000
Twankay	40,000	29,000	30,000	94,000	56,000	46,000	40,000	29,000	30,000	94,000	56,000	46,000
Hyson	676,000	1.066,000	865,000	1,092,000	305.000	483,000	676,000	1,066,000	865,000	1,092.000	305,000	493,000
Young Hyson ...	2,423,000	2,387,000	2,188,000	3,003,000	1,205,000	970,000	2,423,000	2,387.000	2,188,000	3.003,000	1,205,000	970,000
Imperial	409,000	321,000	284,000	472,000	284,000	164,000	409,000	321,000	284,000	472,000	289,000	164,000
Gunpowder	2,974,000	2,834,000	2,798,000	3,309,000	1,696,000	1,320,000	2,974,000	2,834,000	2,798,000	3,309,000	1,696,000	1,320,000
Sorts & Dust ...	719,000	713,000	354,000	1,235,000	675,000	309,000	719,000	371,000	354,000	1,235,000	675,000	309,000
Japan	201,000	160,000	172,000	392,000	272,000	243,000	201,000	150,000	172,000	392,000	272,000	243,000
Java	2,019,000	2,898,000	2,612,000	2,883,000	510,000	1,103,000	2,016,000	2,898,000	2,612,000	2,883,000	507,000	1,103,000
	158,099,000	145,593,000	160,391,000	163,198,000	77,424,000	77,530,000	158,990,000	145,516,000	160,420,000	163,198,000	81,543,000	81,654,000
Indian	45,010,000	38.484,000	43,807,000	35,243,000	20,473,000	17,818,000	45,010,010	38,484,000	43,830.000	35,302,000	21,207,000	18,846,000
Total lbs. ...	203,109,000	184,077,000	204,198,000	198.441,000	97,897,000*	95,348.000	203,000,000	184.000,000	204.250,000	198,500,000	102.750,000	100,500,000
Black	196,587,000	177,440,000	198.033,000	190,471,000	94,351,000	92,355,000	196,478,000	177,363,000	198,085,000	190,530,000	99.199,000	97,507,000
Green	6,522,000	6,637,000	6,165,000	7,970,000	3,546,000	2,993,000	6,522,000	6,637,000	6,165,000	7,970,000	3,551,000	2,993,000

		1880.		1879.
Total delivered		204,198,000		198,441,000 lbs.
Exported	44,771,000		36,627,000	
Sent Coastwise	32,433,000		33,481,000	
		77,204,000		70,108,000
*Home Consumption from London,		126,994,000		128,333,000 lbs.

	1880.	1879.
Total delivered	204,250,000	198,500,000 lbs.
Exported	44,750,000	36,750,000
Home Consumption	159,500,000	161,750,000 lbs.

* Arrived to 31st December, 1880, but not included in the above, about 2,500,000lbs.

N.B. –In consequence of increased weights an addition has been made in the Imports of China Congou of 1,000,000lbs., and Indian 1,000 000lbs. Deliveries: China Cong 2,000,000lbs; Indian, 2,250,000lbs. Stock: China Congou, 2,000,000lbs.; Indian, 1,250,000lbs.

Statistics of Indian Tea during the 17 years (1860—1876).

Year.	Crop.	Imported into London.	Delivered in London.	Stock in London.
	lbs.	lbs.	lbs.	lbs.
1860	1,400,000	1,100,000	1,000,000	800,000
1861	1,400,000	1,500,000	1,300,000	1,000,000
1862	1,600,000	1,800,000	1,700,000	1,900,000
1863	2,300,000	2,600,000	2,300,000	1,300,000
1864	1,500,000	3,300,000	2,800,000	1,800,000
1865	2,700,000	2,500,000	2,900,000	1,300,000
1866	4,900,000	5,100,000	4,400,000	2,100,000
1867	8,500,000	7,000,000	6,200,000	2,900,000
1868	10,800,000	8,100,000	7,300,000	3,700,000
1869	12,500,000	10,500,000	10,500,000	4,200,000
1870	13,200,000	13,100,000	13,500,000	4,300,000
1871	16,400,000	15,300,000	13,600,000	5,900,000
1872	17,900,000	16,900,000	16,300,000	6,700,000
1873	19,700,000	18,400,000	18,400,000	6,900,000
1874	23,300,000	17,400,000	17,700,000	6,700,000
1875	26,100,000	25,600,000	23,300,000	9,500,000
1876	29,400,000	29,100,000	26,700,000	11,800,000

Production of the various Indian Tea-producing Districts.

	Actual Out-turn Crop 1870	Actual Out-turn Crop 1871	Actual Out-turn Crop 1872	Actual Out-turn Crop 1873	Actual Out-turn Crop 1874	Actual Out-turn Crop 1875	Actual Out-turn Crop 1876	Actual Out-turn Crop 1877
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Assam ...	6,400,000	7,500,000	8,700,000	9,600,000	11,200,000	13,200,000	15.500,000	19,000,000
Cachar & Sylhet	4,600,000	5,700,000	5,400,000	5,800,000	6,500,000	6,700,000	8,000,000	10,000,000
Darjeeling, Kurseong, Terai & Doars ...	1,700,000	2,500,000	2,700,000	2,900,000	3,800,000	4,300,000	4,000,000	5,000,000
Kumaon, Kangra Valley, & Dehra Doon ...	600,000	600,000	700,000	1,000,000	1,300,000	1,300,000	1,300,000	1,500,000
Chittagong ...	...	300,000	300,000	400,000	500,000	600,000	600,000	700,000
Chota Nagpore...	...	...	...	...	...	...	100,000	200,000
Total lbs. ...	13,300,000	16,600,000	17,800,000	19,700,000	23,300,000	26,100,000	29,500,000	36,400,000

—*From L. W. Toulmin & Co.'s Price Current for May 18th, 1877.*

STOCKS AND PRICES.

From the year 1870 to the close of year 1880, with the Prices in London on the 31st December in each year.

	Stocks, 31st December 1874.	Prices, 31st December 1874.		Stocks, 31st December 1873.	Prices, 31st December 1873.		Stocks, 31st December 1872.	Prices, 31st December 1872.		Stocks, 31st December 1871.	Prices, 31st December 1871.		Stocks, 31st December 1870.	Prices, 31st December 1870.	
	lbs.	s. d.	s. d.	lbs	s. d.	s. d.	lbs.	s. d.	s. d.	lbs.	s. d.	s. d.	lbs.	s. d.	s. d.
					0 0 to	0 0	17,000	0 0 to	0 0	16,000	0 0 to	0 0	12,000	0 0 to	0 0
Congou	57,883,000	0 9 to	3 2	68,258,000	0 10½	2 8	70,885,000	1 10½	2 8	60,908,000	0 10½	2 5	58,490,000	0 10½	2 10
Pouchong	......	0 0	0 0	......	0 0	0 0	88,000	0 0	0 0	84,000	0 0	0 0	119,000	0 0	0 0
Caper	4,404,000	0 7	2 2	4,214,000	0 5	2 2	4,595,000	0 7	2 6	3,230,000	0 7	2 6	2,801,000	0 7	2 6
Oolong	1,773,000				0 10	2 4		0 10	2 4		0 10	2 6		1 0	2 6
Souchong	3,415,000	0 10	2 3	5,056,000			4,965,000			3,166,000			3,378,000		
Bl. Lf. Pek. or H. Muey ...		1 0	2 8		0 11	2 6	294,000	0 11	2 6	178,000	0 11	2 8	144,000	0 11½	2 6
Pekoe	389,000	1 2	3 6	428,000	2 6	4 6		2 6	4 6		2 6	5 0		2 0	4 0
Orange Pekoe, plain ...		0 0	0 0	3,590,000	0 0	0 0	3,515,000	0 0	0 0	2,162,000	0 10	2 6	2,824,000	0 0	0 0
Ditto scented ...	2,990,000	1 1	2 6				247,000			361,000	0 6	1 0	346,000		
Twankey		0 7	1 0	329,000	0 8	2 4	56,000	0 10	2 6	55,000	1 7	0 10	57,000	0 9	3 6
Hyson Skin	220,000	0 6	0 11		0 6	0 11		0 7	1 0		0 10	3 6		0 7	1 1
Hyson	935,000	0 10	4 0	704,000	0 6	0 11	424,000	0 3	0 11	603,000			933,000	0 6	0 10
Young Hyson	2,702,002	0 8	2 10	2,710,000	0 10	4 0	2,155,000	0 11	4 0	1,763,000	0 7	3 0	2,293,000	0 10	3 6
Imperial	701,000	0 10	2 4	522,000	0 6	2 8	406,000	0 8	3 2	403,000	0 10	3 8	548,000	0 9	2 10
Gunpowder	2,439,000	0 10	3 10	2,986,000	0 10	2 6	2,658,000	0 11	2 10	2,237,000	0 9	4 0	2,443,000	0 10	2 8
Sorts and Dust	741,000	......		852,000	0 10	3 4	785,000	0 11	4 0	737,000	......		738,000	0 10	4 0
Indian	6,786,000	......		6,923,000	......		6,911,000	......		6,301,000	......		4,378,000	......	
Japan	372,000	......		428,000	......		499,000	......		1,041,000	......		247,000	......	
Java	......	......		......	......		......	......		......	......		....	......	
Total lbs. ...	85,750,000			97,000,000			98,500,000			83,250,000			79,750,000		
		Sound com. Con.			Sound com. Con.			Sound com. Con.			Sound com. Con.			Sound com. Con.	
		1 March	1 0½		1 March	0 11½		1 March	1 0½		1 March	0 11½		1 March	1 0½
		1 July	0 11		1 July	0 11		1 July	1 0		1 July	0 11		1 July	0 11
		1 Nov.	0 11½		1 Nov.	0 11		1 Nov.	1 0½		1 Nov.	1 0		1 Nov.	0 11½
Export ... ... lbs.	3,200,000			34,000,000			39,500,000			40,750,000			30,750,000		
Home Consumption ... lbs.	137,500,000			131,500,000			127,500,000			123,000,000			117,750,000		
Total Delivery ... lbs.	169,500,000			165,500,000			167,000,000			163,750,000			148,500,000		
Import ... ... lbs	158,250,000			164,000,000			182,250,000			167,250,000			140,500,000		

[Continued on next page

STOCKS AND PRICES.—(Continued.)

	Stocks, Prices, 31st December 1880.			Stocks, Prices, 31st December 1879.			Stocks, Prices, 31st December 1878.		
	lbs.	s. d.	s. d.	lbs.	s. d.	s. d.	lbs.	s. d.	s. d.
Congou	68,790,000	0 7½	to 2 0	65,102,000	0 7½	to 2 6	76,242,000	0 7½	to 2 2
Pouchong	......	0 0	0 0	......	0 0	0 0	......	0 0	0 0
Caper	3,368,000	0 8	0 9	5,372,000	0 9	2 0	5,250,000	0 7	1 8
Oolong	1,065,000	0 10	1 8	987,000	1 2	2 2	1,252,000	0 9	1 8
Souchong	3,077,000	0 10	2 0	2,844,000	0 11	2 8	4,453,000	0 9	2 6
Bl Lf Pek or H Muey / Pekoe ...	156,00	3 0	3 6	219,000	1 2	3 0	598,000	0 10	4 0
Orange Pekoe, plain ...	2,188,000	0 9	1 6	2,482,000	0 10	2 0	3,791,000	0 0	0 0
Ditto, scented		0 0	0 0					0 8	1 10
Twankay	56,000	0 9	1 1	46,000	0 9	1 1	123,000	0 5	0 10
Hyson Skin ...		0 9	1 0		0 9	1 0		0 4	0 9
Hyson	305,000	1 1	3 0	493,000	0 11	3 8	516,000	0 10	3 6
Young Hyson ...	1,205,000	0 9½	2 4	970,000	1 0	2 6	1,591,000	0 6	2 2
Imperial ...	269,000	0 10	1 6	164,000	0 11	2 0	330,000	0 9	1 8
Gunpowder ...	1,696,000	0 9	3 0	1,320,000	0 11	3 8	1,803,000	0 8	3 6
Sorts and Dust ...	675,000	......		309,000	......		1,133,000	......	
Indian	20,473,000	0 8	4 0	18,846,000	0 11	3 8	15,433,000	0 9	4 0
Japan	272,000	0 9	1 4	243,000	1 0	1 6	473,000	0 8	2 0
Java	510,000	......		1,103,000	......		1,039,000	......	
Total lbs. ...	102,750,000			100,500,000			114,000,000		
Sound com. Con. 1 March			0 11			0 8			0 9
1 July			0 10			0 8			0 8½
1 Nov.			0 8½			0 10			0 8
Export ... lbs.	44,750,000			36,750,000			40,500,000		
Home Consumption lbs.	159,500,000			161,750,000			157,250,000		
Total Delivery lbs.	204,250,000			198,500,000			197,750,000		
Import ... lbs.	203,000,000			184,000,000			201,750,000		

	Stocks, Prices, 31st December 1877.			Stocks, Prices, 31st December 1876.			Stocks, Prices, 31st December 1875.		
	lbs.	s. d.	s. d.	lbs.	s. d.	s. d.	lbs.	s. d.	s. d.
Congou	73,823,000	0 8	to 2 2	80,135,000	0 8	to 2 2	78,930,000	0 8	to 2 8
Pouchong	......	0 0	0 0	......	0 0	0 0	......	0 0	0 0
Caper	3,876,009	0 9	1 10	2,809,000	1 0	2 0	3,521,000	0 7	2 0
Oolong	1,604,00	0 10	1 10	1,330,000	1 0	2 4	1,573,000	0 10	2 0
Souchong	3,909,000	0 10	2 6	3,661,000	0 11	2 6	3,042,000	0 10	2 6
Bl Lf Pek or H Muey / Pekoe ...	311,000	1 0	3 6	194,000	1 0	3 6	271,000	1 2	3 6
Orange Pekoe, plain ...	3,559,000	0 0	0 0	2,379,000	0 0	0 0	3,066,000	0 0	0 0
Ditto, scented		0 10	2 0		1 1	2 6		1 0	2 0
Twankay	170,000	0 5	0 10	193,000	0 6	0 11	213,000	0 7	1 1
Hyson Skin ...		0 4	0 9		0 6	0 10		0 7	0 10
Hyson	594,000	0 10	3 6	914,000	0 10	3 6	1,074,000	0 10	3 6
Young Hyson ...	1,298,000	0 7	2 0	2,219,000	0 7	2 0	2,690,000	0 7	2 0
Imperial ...	298,000	0 10	1 8	565,000	0 10	1 8	717,000	0 10	1 6
Gunpowder ...	1,763,000	0 9	3 8	1,875,000	0 8	3 10	2,621,000	0 8	3 6
Sorts and Dust ...	1,916,000	......		817,000	......		704,000	......	
Indian	16,234,000	......		12,360,000	......		9,485,000	......	
Japan	645,000	......		549,000	......		353,000	......	
Java	......	......		......	......		......	......	
Total lbs. ...	110,000,000			110,000,000			103,250,000		
Sound com. Con. 1 March			0 8½			0 10			0 11
1 July			0 8			0 9½			0 10½
1 Nov.			0 7½			0 9			0 10½
Export ... lbs.	35,500,000			29,250,000			32,500,000		
Home Consumption lbs.	151,000,000			150,250,000			145,000,000		
Total Delivery lbs.	186,500,000			179,500,000			177,500,000		
Import ... lbs.	186,500,000			186,250,000			195,000,000		

Amended Statistics of Tea.

For months past doubts have been expressed as to the correctness of the figures relating to the receipts and deliveries of tea at this port, the returns furnished by the dock and wharf companies not agreeing with those issued by the Customs and Board of Trade authorities. The difference between one set of totals and another has not been a matter of a few hundreds, or thousands, but has amounted to "millions" of pounds weight, and has consequently occasioned some confusion in the minds of many with reference to what have been the quantities of tea actually landed and delivered in London during the past year. The only explanation that could be given was that the calculations from the dock returns were based on the old scale of average weights, whilst the estimates formed in official departments were founded on teas that had been specially weighed. As month after month showed the same inconsistencies between totals representing similar branches of trade, it at last became manifest that the aggregate weight of packages imported had to the unofficial compilers imperceptibly increased, leaving always a net overplus of tea which was never properly taken into account, and which was included only when the Custom House returns were periodically made up. If it had not been for the latter, wherein extra vigilance is shown for the sake of securing every sixpence of revenue that can lawfully be obtained, it is likely that the deficient mode of reckoning might have gone on unnoticed for some time longer, and that the statistical movements of the article for 1880 would have been wrongly and imperfectly represented. A few words will explain how it is that so great a discrepancy has crept in almost unperceived. Half-chests of "Congou" and "Souchong," which were formerly calculated to weigh only 56lbs., or about half a cwt., are now estimated at 60lbs. net, and packages of Indian or Assam tea, usually reckoned at 90lbs., are now known to average 97lbs. each, so that as these are the very descriptions which figure most prominently in all statistics of tea, it is not surprising that the deficit existing between the private estimates and the official amounts, duly ascertained for the purpose of assessing the duty to be charged on the tea passing into consumption, should be so remarkable as we have endeavoured to show.

Fuller particulars, however, are needed to prove the extent to which recent miscalculations have deranged the comparative landings, clearances, and stocks of tea with those in 1879, and we select the totals published by Messrs J. C. Sillar and Co. as the latest and most carefully revised that we have yet seen on the subject. According to their calculations, the total quantity imported into London last year was 206,564,000lbs., of which 137,763,000lbs. were "Congou," and 46.377,000lbs. Assam or Indian; against 185,176,000lbs. in 1879, which included 123,774,000lbs. "Congou" and 37.518,000lbs. Assam. The total deliveries for all purposes were computed at 205,679,000lbs., against 196,490,000lbs., the separate amounts of Congou and Indian being 137,079,000lbs., and 43.835,000lbs. in 1880, against 135,484,000lbs., and 34,097,000lbs. in the preceding year. Equally striking was the amount estimated as stock, *viz*, 100.258,000lbs., as compared with 96,188,000lbs. at the end of 1879, the proportion of Congou on hand being 67,425,000lbs., against 64,288,000lbs. in the previous year, and that of Assam figured as 21,225.000lbs., in contrast with 18,274.000lbs. But it should be remembered that the excess in the landings, deliveries, and stocks, here given, and which in each instance is much larger than before known, would be smaller if the quantities pertaining to 1879 were adjusted by the present method of calculating the actual weights of the chief kinds of China and Indian tea warehoused and delivered.

It is also interesting to observe the great progress which the trade in tea has made within the past seven years. This is best shown by the enormous deliveries that have occurred in the United Kingdom under the three different heads of "Home consumption," "Exported," and "Transshipped," the subjoined statement enumerating these details being likewise taken from Messrs. Sillar's annual review of the London tea market, *viz.* :—

	Home consumption. lbs.	Exported. lbs.	Transhipped. lbs.	Total deliveries. lbs.
1874 ...	137,500,000	31,000,000	8,800,000	177,300,000
1875 ...	145.500,000	31,700,000	11.342,000	188,542,000
1876 ...	149,182,000	27,835,000	6,238 000	183,255,000
1877 ...	151,275,000	35,000,000	13,000,000	199,275,000
1878 ...	157,692,000	39,551,000	8,299,000	205,542.000
1879 ...	160,652,000	36,170,000	8,406,000	205,228,000
1880 ...	158,570,000	42,499,000	11.544,000	212,613,000

—*Grocer.*

Supply of Congou from China in 1881.

It is anticipated that the supply of low red leaf Congou will be small this season, the stock at Foochow being considerably less than usual

ANALYSIS OF THE WORKING OF VARIOUS TEA COMPANIES.

NAME OF COMPANY.	Gross price per lb. including all receipts.		Cost per lb. including all sale charges.		Profit per lb. of Tea.		Dividends.		Yield per acre over old and young cultivation.	Capital per acre over old and young cultivation at PAR value of shares.	Capital per 80 lbs. of Tea manufactured at PAR value of Shares.	Capital per 80 lbs. of Tea at MARKET value of Shares.		REMARKS.
	1878.	1879.	1878.	1879.	1878.	1879.	1878.	1879.	1879.	Par value.	Par. value.	Market price, if	Capital would be	
	s. d.	s. d.	s. d.	s. d.					lbs.	£	£		£	
Borelli Tea Co.	1 11⅜	1 7¼	1 5½	1 2⅛	6⅛d.	5⅛d.	10%	10%	491	106	17	12½	20	
Assam Tea Co.	2 0⅜	1 7⅜	1 6⅜	1 5⅝	6⅛d.	1⅝d.	27%	10%	356	30	7	40	14	3% taken from Reserve to pay 1879 [Dividend
Luckimpore Tea Co. ...	1 10¼	1 7	1 6⅛	1 5⅜	3⅝d.	1⅜d.	8%	4%	370	81	18	Par	18	1½% ditto ditto
Dejoo Tea Co.	1 10⅝	1 6⅜	1 4⅞	1 5½	5⅜d.	1⅛d.	9%	2%	280	90	25	,,	25	
Doom Dooma Tea Co. ...	1 7⅜	1 5⅜	1 5½	1 4⅛	2⅜d.	⅜d.	3½%	2%	348	76	18	,,	18	B Shares. Dividend appropriated to "A" Preference Shares
Jorehaut Tea Co.	1 11⅝	1 4⅞	1 9	1 3½	2⅜d.	1⅛d.	7%	5%	268	26	8	30	12	
Eastern Assam Tea Co. ...	1 6⅜	1 1⅜	1 5⅜	1 3	⅞d.	Loss	Nil	Nil	273	175	51	2½	12½	
Wilton Tea Co.	1 9	1 5	1 6	1 3⅜	3d.	1⅜d.	10%	5%	212	28	10½	1½	16	
Upper Assam Tea Co. ...	1 6¼	1 2⅜	1 5½	1 4⅜	1⅝d.	Nil	Nil	Nil	324	120	30	1½	5	With Debentures, &c.
	R.A.P.	R.A.P.	R.A.P.	R.A.P.	R.A.P.	R.A.P.				Rs.	Rs.			
Dehing Tea Co.	0 12 9	1 10 4	0 9 6	0 8 6	0 3 3	0 1 10	4%	2%	288	910	253	Par	22	
Bishnauth Tea Co.	......	0 12 6	......	0 11 0	......	0 1 6	8%	6%	280	620	143	,,	13	

THE PLANTERS' STORES AND AGENCY COMPANY, LIMITED,
Calcutta and London.

LIST OF INDIAN TEA COMPANIES,

With Ruling Quotations in March 1881.

Paid up Capital.	Share.	Paid up.	NAMES OF COMPANIES.	District.	Closing Prices.		Div. for Season. 1879-80.	
Rs.	Rs.	Rs.						
1,10,000	100	100	Adulpore Terai	Darjeeling ...	80 to	N	4½	...
3,00,000	100	100	Amicable ...	Assam ...	80 to	N	nil	...
3,75,000	100	100	Amluckie ...	Assam ...	55 to	N	nil	4½
3,00,000	100	100	Arcuttipore ...	Cachar ...	100 to	N	nil	...
£1,87,160	£30	£20	Assam Company	......	500 to	N	10	...
2,00,000	100	100	Balasun ...	Darjeeling ...	73 to 74	X	nil	3
1,50,000	100	100	Baree ...	Kangra ...	90 to	N	nil	...
7,62,800	100	100	Bengal ...	Cachar ...	50 to	...	nil	...
1,87,320	100	80	Do. contributory	......	40 to	...	nil	...
3,25,000	200	200	Bishnath ...	Assam ...	215 to 218	...	6	...
	200	100	Do. contributory	......	107 to 109	...	6	...
£78,170	£10	£10	Borelli ...	Assam ...	160 to 165	N	10	...
1,10,000	100	100	Borsillah ...	Assam ...	......	N	nil	...
2,70,000	100	100	Burkola ...	Cachar ...	70 to 71	...	7½	...
10,00,000	200	200	Central Cachar	......	117 to 118	...	nil	3½
4,00,000	100	100	Central Terai ...	Darjeeling ...	64 to	N	nil	...
2,50,000	500	500	Chandypore ...	Cachar ...	325 to 350	N	nil	...
2,50,000	100	100	Chota Nagpore	......	64 to 65	X	3½	...
2,50,000	100	100	Cinatolliah ...	Assam ...	......	N	nil	...
3,00,000	100	100	Colonial ...	Assam ...	60 to	N	nil	...
2,00,000	100	100	Coocheela ...	Cachar ...	50 to	N	nil	...
2,50,000	100	100	Cutlecheera ...	Cachar ...	110 to 112	...	5	...
3,00,000	100	100	Darjg. Tea and Cinchona.	......	360 to 365	X	70	a80
1,300	100	100	Dedur Kosh ...	Cachar ...	35 to	N	nil	...
3,96,610	100	90	Dehing ...	Assam ...	46 to	X	2	...
3,78,000	100	100	Dehra Doon ...	......	75 to	...	...	...
1,80,000	100	100	Dessai and Parbuttia.	Assam ...	55 to	N	5	...
4,66,750	100	100	Durrung ...	Assam ...	36 to	...	4	...
7,00,000	100	100	Eastern Cachar	......	61 to 62	...	2½	2½
10,00,000	100	100	East India ...	Assam & Cachar	33 to 34	...	nil	...
4,00,000	100	100	Gielle ...	Darjeeling ...	70 to	...	nil	...
4,00,000	100	100	Gowhatty ...	Assam ...	30 to	N	nil	...
5,00,000	500	500	Grob ...	Assam ...	250 to	N	nil	...
3,50,000	100	100	Holta ...	Kangra ...	69 to 70	...	nil	...
1,20,000	100	100	Hoolmaree ...	Assam ...	105 to 110	...	8	...
4,00,000	100	100	Hoolungoorie ...	Assam ...	36 to 37	...	nil	...
1,50,000	500	500	Indian Terai ...	Darjeeling ...	350 to 400	N	nil	...
2,20,000	100	100	Jerie Ghat ...	Cachar ...	10 to 15	N	nil	...
1,60,000	250	250	Jellalpore ...	Cachar ...	200 to	N	nil	...
3,00,000	100	100	Jokai ...	Assam ...	70 to	N	nil	...
2,75,000	100	100	Kalacherra ...	Cachar ...	49 to	X	6	...
2,37,500	100	100	Kangra Valley...	......	par	...	...	...
4,56,000	100	100	Kunchunpore ...	Cachar ...	26 to 28	...	nil	...
7,00,000	200	250	Kurseong and Darjeeling.	......	70 to	...	nil	...
	200	250	Do. contributory	......	46 to 50	...	nil	...
1,00,000	5,000	5,000	Kuttal ...	Cachar ...	12000 to	N	15	...
2,25,000	100	100	Lackatoorah ...	Sylhet ...	59 to 60	N	nil	...
5,00,000	100	100	Loobah ...	Sylhet ...	125 to	N	2	6
£58,494	£10	£6½	Lower Assam ...	......	8 to 10	N	nil	...
£70,590	£10	£10	Luckimpore ...	Assam ...	120 to	N	4	...

N.—Nominal. X.—Ex-dividend. A.—Ad-interim.
Y.—Dividend for the year

LIST OF INDIAN TEA COMPANIES,—*(Continued.)*

Paid up Capital.	Share.	Paid up	NAMES OF COMPANIES.	District.	Closing Prices.		Div. for Season. 1879-80.	
1,75,000	100	100	Majagram ...	Cachar ...	44 to 46	...	nil	...
1,60,000	100	100	Mim ...	Darjeeling ...	50 to	N	nil	...
7,29,150	100	100	Monacherra ...	Cachar ...	44 to 46	...	nil	...
	100	90	Do. contributory	......	32 to 33	...	nil	...
4,60,000	100	80	Moran ...	Assam ...	30 prem	N	8	...
,83,000	100	100	Mothola ...	Assam ...	55 to 60	N	nil	...
	100	90	Do. contributory	......	45 to 50	N	nil	...
£1,54,980	£10	£10	Mungledye ...	Assam ...	......	...	nil	...
2,98,125	200	200	Muttuck ...	Assam ...	100 to	Y	nil	...
	200	125	Do. contributory	......	50 to	N	nil	...
2,00,000	100	100	New Fallodhi ...	Darjeeling ...	50 to	N	nil	...
£16,000	£10	£10	New Gola Ghat	Assam ...	100 to	N	...	...
1,17,750	30	30	New Mutual ...	Cachar ...	100 to	N	9	...
4,00,000	200	200	Nutwanpore ...	Cachar ...	180 to 200	N	...	...
1,50,000	100	100	Panbarree ...	Assam ...	26 to 30	...	nil	...
5,10,000	100	85	Phœnix ...	Cachar ...	65 to	X	7	...
1,75,000	100	100	Punkabaree ...	Darjeeling ...	85 to	X	7	4½
2,00,000	100	100	Puttareah ...	Sylhet ...	40 to	N	nil	...
2,00,000	100	100	Rajabarree ...	Assam ...	104 to 105	N	nil	...
10,000	100	15	Ring Tong ...	Darjeeling ...	par	...	...	...
1,12,000	100	100	Rungle Rungliot	Darjeeling ...	nominal	...	...	...
88,000	100	100	Sapakati ...	Assam ...	100 to	N	...	...
£79,590	£10	£10	Scottish Assam	......	nominal	...	..	...
2,17,500	60	50	Second Mutual	Cachar ...	20 prem.	N	5	...
3,00,000	100	100	Singbulli and Murmah.	Darjeeling ...	80 to 85	...	3	...
6,25,000	100	100	Singell ...	Darjeeling ...	72 to 73	...	5½	...
3,00,000	100	100	Soom ...	Darjeeling ...	60 to 61	...	2½	2½
1,68,000	100	100	Springside ...	Darjeeling ...	88 to 89	...	8	5
2,00,000	100	100	Sungoo River ...	Chittagong ...	80 to 85	...	nil	...
1,35,000	100	100	Teendarrea ...	Darjeeling ...	80 to	...	4	...
3,50,000	100	100	Teesta Valley ...	Darjeeling ...	95 to 96	...	nil	7
1,20,000	100	80	Ting Ling ...	Darjeeling ...	85 to 86	N	nil	...
7,34,300	200	200	Tukvar ...	Darjeeling ...	152 to	X	6	a3½
£1,99,224	£10	£10	Upper Assam ...	......	30 to	N	...	...

N.—Nominal. E.—Ex-dividend. A.—Ad-interim.
Y.—Dividend for the year.

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LONDON TEA COMPANIES.

Comparative Analysis, &c., of the Accounts of Twelve of the principal Companies for Season 1879.

	Area of Old Plant.	Area of New Plant.	Total Area under Plant.	Capital paid up.	Capital paid up represents per acre.	Market Value of Capital paid up.	Market Value of Capital paid up represents per acre.	Production of Leaf.	Production of Leaf per acre.	Average Price obtained per pound.	Gross Receipts from all sources (including profit on exchange.)	Expenses.	Expenses represent per pound.	Expenses represent per acre.	Net Profit.	Estimated production of Leaf in 1880.	Estimated increase of Production in 1880 over 1879.	Dividends per cent. from Seasons 1877.	1878.	1879	Shares are of	Shares have paid up.	Market Price of Shares.	Return to an Investor calculated on last 12 months' dividend —per cent.	
	Acres.	Acres.	Acres.	£	£	£	£	lbs.	lbs.		£.	£		£ s.	£	lbs.	lbs.				£	£	£	£	
Assam ...	...	...	6000	187,160	31	467,900	78	2,077,625	346	1/5⅛	171,717	156,818	1/6	26 3	14,899	2,2[illegible]9 700	162,075	25	27	10	30	20	50	4	Assam.
Borelli ...	511	229	740	78,170	106	101,621	137	358,807	485	1/5½	29,058	21,193	1/2⅛	28 13	7,865	384,000	25,193	14	10	10	10	10	13	7½	Borelli.
British Indian ...	1326	721	2047	243,300 Ordy. 11,836 10°/o Deb	125	72,661	35	391,934	191	1/3½	26,398	26,049	1/3⅞	12 15	348	...	...	Nil.	Nil.	Nil.	20	20	5	...	British Indian.
Darjeeling ...	...	...	1534	135,420	88	176,046	115	466,934	304	1/5¼	37,766	29,567	1/2½	19 5	8,199	528,000	61,066	9	9	6½	20	20	26	5	Darjeeling.
Dejoo ...	225	117	342	30,000	88	27,000	79	92,300	270	1/5¾	7,965	7,378	1/7⅛	21 11	587	120,000	27,700	...	9	2	10	10	9	2¼	Dejoo.
Eastern Assam ...	...	...	764	122,240	160	18,336	24	192,699	252	1/1¼	10,777	12,254	1/3¼	16 1	1,477 (Loss)	...	...	Nil.	Nil.	Nil.	10	10	1½	...	Eastern Assam.
Jorehaut ...	3441	288	3729	100,000	27	195,000	52	1,015,560	272	1/2¾	71,568	66,972	1/3⅞	17 19	4,595	1,154,880	139,320	15	7½	5	20	20	39	2⅝	Jorehaut.
Lebong ...	597	297	894	82,070	92	98,484	110	220,515	247	1/3¼	17,999	12,763	1/1⅞	14 6	5,236	2[illegible]0,000	20,515 Decrease	8	8	8	10	10	12	6⅝	Lebong.
Luckimpore ...	764	147	911	70,590 3,131 New.	81	72,938	80	322,520	354	1/4⅛	25,638	23,703	1/5⅝	26 0	1,935	[illegible]	49,960	10	8	4	10	10	10	4	Luckimpore.
Mungledye ...	...	...	1487	154,980	104	69,741	47	445,177	299	1/1¾	29,170	28,298	1/3½	19 1	872	50[illegible],000	5[illegible],823	2	Nil.	Nil.	10	10	4½	...	Mungledye.
Scottish Assam ...	...	...	650	79,590	122	39,795	61	157,814	243	1/5¾	13,553	11,736	1/5⅞	18 1	1,817	204,000	46,186	Nil.	Nil.	2¼	10	10	5	4¼	Scottish Assam.
Upper Assam ...	1416	1194	2610	189,250 Ordy. 10,000 15°/o Pref 40,500 10°/o Deb 73,478 5°/o Deb.	120	166,559	64	837,298	321	1/2¼	59,361	65,833	1/6⅞	25 4	6,472 (Loss)	986,800	149,502	Nil.	Nil.	Nil.	10	10	2¼	...	Upper Assam.

All the Companies, except the Assam, are "Limited."

The Assam Company has a Reserve Fund of £36,214.

Although the Capital of the Lebong Co. appears in the Table as £82,070, the amount really invested in the gardens, as per the last Balance Sheet, is only £31,748, there being over £50,000 invested in United States Government Securities, and deposited with various Banks. This arises from their having sold an outlying portion of their property some years ago. The proceeds await the opportunity of favourable investment in tea gardens. Taking £31,748 as the Capital, it represents only £35 per acre, and at its increased market value, still only £42 per acre.

The figures given above are believed to be correct, but we do not accept responsibility for any errors that may exist. Intending investors can have copies of the various Reports from us for perusal.

HORNE & SMITH,
Stock-brokers.

Aberdeen, November, 1880.

PRICES OF SHARES OF LONDON COMPANIES.

Paid up Capital.	Share.	Paid up.	Name of Company.	District.	Acres under Cultivation.	Produce of Tea of Season 1879.	Dividends. 1877.	1878.	1879.	Present Price.	Remarks.
£	£	£				lbs.	Per cent.				
193,337	30	20	Assam ...	Assam ...	6,000	2,134,223	25	27	10	42 —45	£40,030 Reserve Fund.
78,170	10	10	Borelli ...	Do. ...	785	373,293	14	10	10	14½—15¼	
114,500	25	25	Brahmapootra ...	Do. ..	1,970	642,441	18	16	13	35 —40	
243,300	20	20	British Indian ...	Cachar & Assam.	1,995	......	Nil	Nil	Nil	3½— 4½	£11,836 10 per cent. Debentures.
135,420	20	20	Darjeeling ...	Darjeeling ..	1,534	475,593	9	9	6½	25 —27	
30,000	10	10	Dejoo ...	Assam ...	342	93,639	Reg. 1877	9	2	10 —11	
89,361	10	9	Dehing ...	Do. ...	982	282,757	Reg. 1877	4	2	7 — 8	
A25,000 B75,000 Ord13,500	10	10	Doom Dooma ...	Do. ...	1,485	517,454	8 Nil Nil	8 Nil Nil	8 Nil 2	A12¾ to 13¼ B10 to 10½ Ord.10½-11½	A Shares, 1st Issue £25,000, 8 p.c., preference until 8 per cent. paid on entire capital from 1st Jan. 1877.
122,240	10	10	Eastern Assam ...	Do. ...	764	192,640	Nil	Nil	Nil	10 —11	£5,000 7 p.c. Debentures, £10,000 Debentures.
17,540	5	5	Jhanzie ...	Do. ...	400	84.159	Reg. 1878			1 — 2	
100,000	20	20	Jorehaut ...	Do. ...	3,821	1,027,675	15	7½	5	5½— 5¾	
264,624	17½	2½	Land Mortgage Bank	Do. ...	6,111	870,800	2/ per share	2/	1/	36 —40	
82,070	10	10	Lebong ...	Darjeeling ..	894	220,515	8	8	8	1 — 1½	£40,291 unexpended. £4,000 Reserve Fund.
58,494	10	6¼	Lower Assam ...	Assam ...	554	147,768	2	31/5	4	11 — 12	
Old70,590 New3,181	10 10	10 2	Luckimpore ...	Do. ...	911	330,884	10	8		7½— 8½ 1¾— 2¼	
48,000	10	8	Moran ...	Do. ...	573	193,600	8	5	3	6 — 7	
154,980	10	10	Mungledye ...	Do. ...	1,487	454,360	2	Nil	Nil	8½— 9½	
84,000	40	30	Nonkacharee ...	Do. ...	1,816	506,649	Nil	Nil	Nil	par	
12,666	5	5	Samdang ...	Do. ...	247	12,080	..	...	...	4¾— 5¼	£1,519 unexpended.
79,590	10	10	Scottish Assam ...	Do. ...	558	159,397	Nil	Nil	2¼	4 — 5	
25,000	10	10	Tiphook ...	Do. ...	705	......	16	N	10	8 — 10	
194,224	10	10	Upper Assam ...	Do. ..	2,610		Nil		Nil	1¾— 2¼	Debenture debt £113,978. Preference shares £10,000.
Old20,000 New4,000	1	...	Walton ...	Do. ...	85	1,000	10			—	The new shares get no dividend till about February, 1881.

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